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IMPROVING CONDITIONS.

Elsewhere in this issue will be found a report of the meeting held by the American Trade Press Association last week, to consider the financial situation, and to throw its influence in support of measures tending to restore confidence and check the hoarding of money. This meeting, at which all branches of the technical and trade press were represented, was addressed by Mr. Henry L. Doherty, past president of the National Electric Light Association, who as the active guide of a score of public utilities and as an economic student, has had to deal at first hand with many of the problems involved in the situation and has reached some striking conclusions as to the evils and their readiest remedies.

We can earnestly recommend to our readers the perusal of the remarks quoted in our columns from the speech made by Mr. Doherty, regretting that the synopsis does much less than justice to its thoughtful and vigorous argument. All of us must support him in his protest against the hoarding of money, whether by individuals or by banks; and all of us must respond to his appeal for the exertion of every influence to restore cheerfulness, courage and confidence. The very fact that such a meeting is held, that such a heartening address is delivered, and that such ringing resolutions have been adopted, helps to bring about the very conditions sought and which every underlying element of national welfare and prosperity justifies. What Mr. Doherty and the American Trade Press Association have done, every public-spirited man and every patriotic body ought to do and can do.

DISHPAN GROUNDS.

A suggestion made by Mr. R. T. Rossi at the Colorado Electric Light Convention, in September, as to the form of ground plate to be used in dry, sandy soil may be worth more attention than the brief space accorded to it in the convention proceedings. This form of ground plate, which has been used to some extent on the lines of the Northern Colorado Power Company for lightning-arrester grounds, consists of a copper pan so placed that whatever moisture descends from the ground above is held in the pan. While Colorado immediately east of the Rocky Mountains is not absolutely devoid of rain, the precipitation is so light that for much of the year the ground is very dry where there is no irrigation. The conditions are, therefore, about as trying as any which can be found as regards securing good ground connections. How far the principle of retaining moisture in a pan-shaped ground immediately after a rainfall holds in dry times is a matter worth experiment. It is to be expected, of course, that in the course of a season the wet earth contained in the pan will gradually be transferred by capillary action to the surrounding dry earth. It is also conceivable that the earth or gravel all around the ground might become so dry that even the moist dishpan ground would be fairly well insulated. These are matters which need trying

out in different soils and climates. The question of getting good grounds for secondary circuits in order properly to protect customers, is one of the very first importance. In some cities ground plates and ground rods work very well when buried in moist clay. In rocky and sandy soil, and even in damp Eastern climates, ground plates have been found very unreliable, so that recourse has been made to waterpipe connections or to continuous grounded neutral wires run over an entire district.

The International Electrotechnical Commission.

The international electrotechnical commission, reference to which is made this week on page 1032, was inaugurated by the resolution of the Chamber of Delegates of the International Electrical Congress at St. Louis, in 1904. The duties which lie before such a commission are easy to define in outline, but difficult to execute in detail. It is manifest to the briefest enquiry that there are certain mechanical and physical properties of electrical machines that are the same at all parts of the earth's surface and are not changed when the machine is carried from one country to another. For example, one of these properties is the temperature elevation of the machine under an assigned steady load, and under assigned environing conditions of air temperature and pressure. It is illogical to the verge of ridicule that any piece of electrical apparatus should have a rating of, say, 100 kilowatts in one country, and of, say, 120 kilowatts in an adjacent country. Such discrepancies tend to bring discredit upon applied science and upon engineering. Everyone will admit that a machine should have one and the same rating in all parts of the world. The only way in which to eliminate discrepancies in the rating of machines is for electrical engineers in all countries to agree upon a common set of rules and specifications under which ratings shall be assigned.

In some particulars, international agreement is facilitated by deferring the period of such formal international action, while in other particulars, lapse of time tends to make international agreement more difficult. In regard to the general advance of applied science, every year makes international agreement easier upon technical questions; because knowledge and experience eliminate obscurity, and general understanding of difficulties in the behavior of machines becomes more precise. The general advance of civilization and mutual good will also tend, as time goes on, in the same direction. On the other hand, delay in reaching international agreement on such important matters as determining the rated output of a dynamo, makes uniform agreement more difficult. This is for the reason that every year sees national standardization rules in firmer position and more rigid local control; so that where there may be disagreement between the rules adopted by the electrical engineers of America, Belgium, England, France, Germany, Italy and other countries, the local practice may be so closely connected with such rules that no agreement or compromise may be forthcoming. Already these differences of detail in national standardization rules are becoming conspicuous, although no differences of detail yet appear on the surface to be ineradicable.

Up to the present time, three years after the St. Louis congress, very little has been accomplished towards international standardization except the formation of local national committees. There is nothing to criticise in the formation of national committees looking towards international cooperation. On the contrary, such organization is to be commended. At the same time, over-organization is one of the best means for involving procrastination and delay that the history of nations has yet produced. If a doubtful scheme is advanced by enthusiasts, there is no better way of deferring it indefinitely, than by establishing a large and dignified international commission to consider it. The time required to accomplish any result varies possibly as the cube of the number of men engaged in committee work for its accomplishment. It is, therefore, earnestly to be hoped that at the next meeting of the committee some definite step may be taken towards adopting uniform international standardization. Fortunately, there is no difficulty of weights and measures to stand in the way. Electrical machine outputs are always either directly expressed in kilowatts or capable of being so expressed, and the methods of electrical testing do not introduce any conflict between national units of measure. In this respect, the task before the international commission is much easier than a corresponding duty before mechanical engineering associations would involve.

Armature Reaction of Synchronous Alternators.

When one compares the effect of the armature m. m. f. upon the field magnetism in a direct-current machine with the corresponding effect in a single-phase machine, he finds that in the former machine the armature m. m. f. occupies a constant position with reference to the main field and it varies in value only as the load changes, while in the latter machine the armature m. m. f. alternates in value and is carried along synchronously with the rotation of the armature. In a polyphase machine the m. m. f.'s of the several armature phases combine to produce a resultant m. m. f. which, although fluctuating somewhat in strength and vibrating in position at double the circuit frequency, yet occupies a mean position with respect to the main field magnetism, which varies merely with the value of the load current and its time-angle of "lag" of "lead." If the current were exactly 90 time-degrees out of phase with the internal generated e. m. f. of the alternator, the armature m. m. f. would directly assist or oppose the field circuit m. m. f. in producing magnetism, but if the current were directly in time-phase with the internal e. m. f. it would not directly affect the main field magnetism, but would merely produce a "reactive field" in electrical space quadrature with the main field. When the angle of Θ of time-phase displacement is less than 90 deg., but greater than zero deg., the equivalent single-phase current I can be considered as made up of two components, in electrical-space and electrical time quadrature, $I \sin \Theta$, which directly assists or opposes the main field magnetism, and $I \cos \Theta$ which produces true "reactive" flux.

As clearly shown by Prof. A. S. Langsdorf on page 1046 of this issue, if the reluctances of the path of the main field magnetism and that of the path of the reactive flux were equal, then the effects of the "armature reaction" and of the magnetic reactance of the armature could be combined vectorially and considered as due to a single equivalent "synchronous reactance." The article by Prof. Langsdorf furnishes an excellent proof of the accuracy of the simplifying assumptions upon which all practical mathematical treatments of the phenomena of synchronous alternators have been based—with almost no excep-

tions without any proof whatsoever. It is worthy of special notice that the simplifying assumption, the accuracy of which is proved in the article in this issue, hold true only under the exact conditions stated, which conditions do not exist in any commercial alternator. That is to say, the reluctance of the path of the main field magnetism is not only not equal to that of the path of the reactive flux, but it varies greatly with the degree of saturation of the field magnets, and the results obtained from any method of analysis involving the use of a constant "synchronous reactance" differs from test results in so far as the several reluctances are not equal in value and constant under all operating conditions.

COLOR PHOTOMETRY.

We print this week a valuable résumé of this important subject by Mr. J. S. Dow, well known to photometrists by his researches on the Purkinje phenomenon and kindred matters. Just at the present time color photometry is taking on a commercial importance which until recently it has lacked. A very few years ago Purkinje's phenomenon was merely a thing to promote wrangles among physiologists; to-day it is in a position to promote lawsuits for large damages, by reason of the fact that it comes strongly into action under conditions all too common in street lighting. The main difficulty in the matter is that very little is definitely known about color perception. It is one of the subjects which have been neglected by the physicists for lack of physiological training and mishandled by the physiologists through neglect of the ordinary precautions of physical investigations. The literature of the subject is scattered almost beyond the possibility of collection and requires very critical examination if collected. A few brilliant investigators, in part physicists, in part physiologists, have now given the subject a start which bespeaks real progress in the near future. The theory of rod and cone vision closely approximated by Abney, Charpentier and others, and put into definite form by Von Kries, has given a basis of scientific investigation which before was lacking.

The chief difficulty in experimenting on color photometry is that the lights are not only very different in hue but present wonderfully impure color effects, which mask the real sources of error. In comparing, for example, a Welsbach mantle with an electric glow lamp one has two lights of notably different color, yet with very large common components. A third source, almost identical with one or the other in general effect, but with a discontinuous spectrum, would give radically different results. Much of the early work carried on with so-called "red" and "green" or "blue" glasses must be thrown aside entirely as hopelessly indefinite in its data. Even in some recent work one finds physiologists blandly stating that they worked with a certain "non-spectral" color; *i. e.*, some sort of mixture, the relations of which to the primary color sensations were unknown or ignored. Mr. Dow has done photometry a good turn in emphasizing the practical importance of the absorption of the yellow spot, which has been in part confused with Purkinje's phenomenon. The former effect, being probably a fine case of selective absorption, appears in the absorbing region whatever the intensity of the light, being naturally rather more conspicuous when the light is not too dazzling. The latter becomes striking only at very low intensities, depending as it does on the weakening of the cone vision at low illuminations. The absorption of the yellow spot is often noticeable on reversal in using the ordinary Lummer-Brodhun screen. As a matter of fact, it affects chiefly the conspicuously blue end of the spectrum, while Purkinje's phenomenon is most in evidence at the other end.

Between the two there is a hard outlook for the accurate photometry of colored lights. It is possible, of course, to compare two lights in detail by the spectro-photometer, but the process is laborious. Crova's method, based on photometric comparison of the spectral region of highest luminosity, gives a simpler way to the same practical end, but is open to the objection that it might be unfair to sources giving discontinuous spectra. We think that Mr. Dow has somewhat overestimated this failing. There is a central region of the spectrum which is very slightly affected by the absorption of the yellow spot and within which the Purkinje effect is quite insignificant, save at values of the illumination impracticably low. Were Crova's limits thus somewhat widened, his method would remain fair even for sources giving discontinuous spectra, since these have a luminous value practically proportional to the radiation within about the same limits as in case of continuous spectra.

Aside from this the human eye is non-achromatic and brings rays of different color into focus in different focal surfaces within the eye. The relation of the retinal surface to these, as due to the configuration of the eye, determines the extent of accommodation required to bring various colored images into focus. Young people can accommodate, starting with normal vision, over a range wide enough to cover a multitude of peculiarities. With abnormal vision and in middle life when accommodation is rapidly failing, the difficulties noted by Mr. Dow multiply and a change in color of illumination would demand suitable glasses to avert eye strain. Hence one is on rather uncertain ground in acuity tests in color photometry. Mr. Dow seems to share a certain distrust of the flicker photometer, which is not uncommon among practical photometrists. The early reports from this type of instrument were very sanguine. When it began to be claimed, however, that the same results were reached by red-blind patients and persons with normal color vision, natural suspicions arose. Obviously if the red component of the light were properly evaluated in the flicker instrument, its removal from perception must change the result. Very possibly, however, the net effect of the flicker is to give predominance to the central region of the spectrum, of high luminosity, so that one might reach an average result, which would be upon the whole fairer to lights of different color than the premises would indicate. For this reason the flicker photometer deserves to be followed up until its color peculiarities are well worked out. At present, illuminants of striking and sometimes bizarre colors are multiplying and demand proper means of photometry. Further, in illumination tests the color is often modified by light reflected from the interior finish so much as to produce a chance for material errors. Color photometry is therefore a very vital question and one that deserves immediate attention. It has reached the point where it is important in the commercial sense as well as being a subject profoundly interesting and well worth study on its own account.

International Electrotechnical Commission.

From time to time references have been made in these columns to the Electrotechnical Commission organized by cooperation of the leading electrical engineering societies of the world. Below is given a statement in detail relating to the organization of the commission and its objects.

The meeting leading to the formation of the commission was held in London, in June, 1906, at which delegates from some 14 countries were present. Lord Kelvin was elected the first president and Colonel R. E. Crompton, C. B., honorary secretary. A set of proposed rules relating to the general organization of the commission was drawn up and adopted, subject to ratification by the bodies which had appointed the delegates. These rules have been practically accepted by all of these and will come up for final action at the first meeting of the council, which is set for next summer. The rules are based upon all countries being on an equal footing with equal taxation and equal voting power; they provide for the manner in which recommendations are to be arrived at and place the affairs of the commission and the method of carrying out its objects in the hands of a representative council, consisting of the president of the commission, the presidents of the local committees, who are vice-presidents of the commission ex-officio, one delegate from each of the local committees and the honorary secretary.

The general objects of the commission are set forth in the following resolution, adopted by the Chamber of Government Delegates at the International Electrical Congress held at St. Louis, in September, 1904:

"That steps should be taken to secure the cooperation of the technical societies of the world by the appointment of a representative commission to consider the question of the standardization of the nomenclature and ratings of electrical apparatus and machinery."

Up to the present time local committees have been appointed in Austria, Belgium, Denmark, England, France, Germany, Hungary, Mexico, Sweden and the United States; and the question of appointing a local committee is also being considered in Australia, Canada, Japan, New Zealand, Russia, South Africa and Switzerland. In a movement of this nature progress must necessarily be slow, but the fact that so many countries have already appointed committees is not only very gratifying but shows the interest taken in electrical standardization throughout the world.

From the commencement the Institution of Electrical Engineers of Great Britain has taken a very prominent part in the matter and not only has it defrayed the preliminary expenses but has most generously granted a substantial loan to the commission in order that no financial difficulties should hamper the work of organization during the first year. The success which the movement is meeting on all sides will not, however, necessitate any great inroads being made into the funds placed at the disposal of the honorary secretary by the Council of the Institution.

At the end of the last year the British local committee appointed a sub-committee on nomenclature, under the chairmanship of Mr. A. P. Trotter, the electrical adviser to the Board of Trade. This sub-committee is now engaged in drawing up a list of terms, with their explanations, in general use in the electrical industry, and the council of the commission will most probably publish a glossary of electrotechnical terms in French and English, the languages in which it has been decided all reports of the commission are to be published. Under nomenclature is to be included the question of symbols, which will be taken up at a future date. When the local committees in the different countries have settled down to work, the British committee will appoint a sub-committee on electrical machinery and apparatus to consider in particular what matters can be brought to the notice of the commission with a view to possible international agreement. The British local committee is working in conjunction with the local committee of those countries taking part in the labors of the commission, and the secretaries of the various local committees are kept in touch through the medium of the central office now established in London at 28 Victoria Street, Westminster. The secretarial work of the central office is in charge of Mr. C. le Maistre, A. M. Inst. C. E., the acting secretary of the commission, to whom all inquiries should be addressed.

Financial Meeting of the American Trade Press Association.

A special meeting of the American Trade Press Association was held at the Hardware Club, New York City, on Nov. 21, in response to a call from President E. C. Brown, which said: "The meeting is called for the purpose of considering the conditions now prevailing in commercial and financial affairs and to determine what action should be pursued by this association and its members in assisting to restore public confidence, so ruthlessly shocked by the recent troubles among our local banking institutions and which is powerfully augmented by the 'currency' disturbances now prevailing throughout the length and breadth of the land. As exponents of the financial, commercial and manufacturing interests of the United States, the trade press must assume its natural position and at this critical juncture offer substantial evidence of its ability to lend material aid in stemming the tide now so strongly set against normal business operations."

Mr. Brown in calling the meeting to order emphasized the points made in the call, and stated that the subscribers and advertisers of the publications looked to them for all the assistance in their power. Their editorial columns should show independence of spirit in considering these weighty affairs, especially in dealing with the attitude of the banking community in regard to the merchant, the manufacturer and business people in general.

Mr. T. C. Martin stated that Mr. Henry L. Doherty was present by request to address the association. This gentleman, past president of the National Electric Light Association and of the Ohio Gas Light Association, and now prominent in a score of public utility corporations, had made economic questions a close study and his method of rate charging is familiar on both sides of the Atlantic. In administering these large interests Mr. Doherty, as an economist and analyst, had been led to diagnose closely the conditions noted by Mr. Brown and had addressed himself to an examination of the present state of affairs with a care more than ordinary, with results and data that would be very interesting at this juncture.

Mr. H. L. Doherty then made a most admirable address dealing with the financial stringency, the hoarding of money, the retrenchments in industrial enterprises, and the remedy for existing anomalous conditions, urging that a body like the American Trade Press Association has a large power to influence events favorably. Amongst other things, he said:

"Retrenchment is not the cure for the condition which now confronts us, but is the result of such a condition, either by anticipation and voluntary retrenchment or eventually enforced retrenchment. Every business enterprise which is making any unnecessary retrenchment is adding just that much to the situation which is bringing about a threatened industrial depression.

"In the parlance of the electrical business, 'contraction or expansion in business is a self-exciting process'; that is, every contraction induces further contraction and every expansion induces further expansion.

"If the situation were not so serious it would be almost ludicrous. The situation that confronts us is not incurable, and, in fact, is not even difficult. We are suffering merely from the lack of confidence. United effort on the part of the men of influence of this country could quickly restore the confidence which is lacking, but unfortunately they have as yet no means of taking united action, no attempt has heretofore been made to do so, and of the numerous half-baked suggestions which have been offered as a cure, few, if any, would stand the analysis of proper logic.

"The burden of present conditions rests primarily with our leaders in finance and business. These men have proved themselves the most capable of all by the well recognized law of 'The survival of the fittest.' They are the natural leaders of men, and are supposed to possess the highest order of intelligence; but in spite of this boasted intelligence and universally recognized ability, no attempt has been made to formulate a plan to secure united action for the execution of this plan to avert the extremely serious condition which now threatens us.

"The principle of united action is universally recognized by all groups of men other than these; and it is a fact worth noting that if any other group of men—no matter how low in order of intelligence—were suffering from a common menace they would co-operate and by united action do what they could to relieve or better their condition.

"In times like these, where it is simply a question of restoration of confidence, the very fact that a large number of men would express their willingness to do anything, or even to express their faith, by active co-operation, that something could be done, would in a large measure improve present conditions, if not entirely cure them.

"The correction of this condition can be summed up in a few words: Find some way, or ways, to bring the hidden money back into circulation before retrenchments have taken place to a point which will not permit re-extension to normal conditions.

"The value of the ordinary business enterprise is not alone the value of its tangible property. In fact, the tangible assets of any business are often far less than its intangible assets. Their selling organization, their good will, their managerial organization and their corps of skilled workmen may represent a value far in excess of the tangible property. Unnecessary retrenchment reduces the value of these intangible assets, and a shut-down—even though intended to be only temporary—often dissipates them all and wipes out their value entirely, and also sometimes reduces the value of the physical property to that of junk.

"The average business man facing the situation of inability to secure money for his immediate needs is very apt to turn toward retrenchments without due consideration to the fact that the very great degree of present stringency of money insures a plentiful supply later on.

"The main thing now is to convince the men who are leaders in industrial business affairs, first, that it is possible for them to continue, in most instances, without retrenchment with the assurance that an abundance of money will be available in the near future, and, second, to interest them in coaxing this hidden money into circulation. It is proposed, for example, to organize a bureau here in New York in which every responsible business, or responsible business interest, that is willing to take the responsibility of doing so, can recommend the purchase of securities, provided they are willing to make this recommendation to their employees and friends as well, and make the communication so read. It is proposed to notify all people seeking investments that this bureau is at their disposal.

"It is proposed to make this an exchange bureau of information where men seeking a buyer or lender can find him, and the man who is seeking an investment can find out just what is available, and either by the exercise of their own judgment or through conference with their friends, find a satisfactory way to invest or loan their funds.

"It is also proposed that this bureau receive and duplicate all plans for enabling the purchaser and the seller or the borrower and the lender to get together. It is also proposed to give out this information to the other cities throughout the country and invite their co-operation with the New York bureau. It is proposed to induce the press to convince the owners of hidden money that now is their opportunity to safely invest or lend it. It is also proposed to induce the press and others to bring influence to bear on the banks to induce them not to attempt to increase their reserves at this time, but to put all possible money in circulation that they can possibly do. It is also proposed to induce all of the banks to take out the limit of their circulation for the relief of the present conditions. It is proposed to formulate some plan that will enable both the active and inactive constructionists to at least record themselves as supporters of all plans for improvement."

Mr. John A. Hill said that it was their duty to teach the people that it is absolutely wrong to hoard money; that the money does not belong to them. The cash that any person has is not totally his; he is only entitled to the use of it. A man who paid an assessment for fixing a sidewalk might as well claim the walk as his own and put people off it. The people own the sidewalk and they also own the circulating medium. As soon as any one takes out of circulation the money which is the medium of exchange, he takes something which he has no right to. The medium of exchange belongs to the whole people, and does not belong to any individual further than as a medium for conveying a given amount of value. A man has no right to take $50,000 out of bank and say: "This is my money." It is not his money. It is a public convenience, just as the railroads are, just as the other roads and rivers and sidewalks and sewers are. No man has a right to take and stake out his part and say that he will hold that for his personal use. If a man owns 10 per cent of another man and says that the 10 per cent he owns is blood, that puts the other man out of business entirely if he takes that part out. In short, they must teach people that the $12.50 or $15 in their pants' pockets doesn't belong to them to hoard and hold there.

Mr. John R. Dunlap spoke in favor of the "practical expedients" that could be immediately applied in cases where men have property and cannot get money. There are railroad and other bonds in the country better than even government bonds.

Mr. J. H. McGraw cited one or two instances where there had been restriction of business not from lack of orders, but from the inability to get money to pay help. Any step, therefore, to re-establish and increase the public confidence is desirable. As publishers they did not realize their influence, and it was their duty in a conservative way to get together and start this good work for the public welfare. He was not frightened by the future. "The good sense, the common sense of the American people will soon assert itself, and ways and means along the lines of Mr. Doherty's suggestions will be provided to draw the hidden money out." He deprecated hoarding by banks and insurance companies.

Mr. C. T. Root suggested the formation of a committee to give shape and force to the discussions of the afternoon so as to help restore confidence and to reach those who hoarded, whether banks or other concerns.

On motion to the effect of appointing such a committee President Brown appointed with power to act on behalf of the association Messrs. James H. McGraw, C. T. Root, John A. Hill and David Williams, with himself as ex-officio, said committee to be known as "The Committee on Public Relations."

At a full meeting of the special committee on Nov. 22 the following resolutions were adopted:

RESOLVED, That the so-called business depression now paralyzing the industries of this country is due principally to a want of confidence which is unwarranted by agricultural and industrial conditions, and that one of the worst results of the panicky feeling that prevails is the hoarding of money, in which many banks are principal offenders—many holding much more cash than the reserves called for by the banking laws, and setting a most hurtful example to individuals.

RESOLVED, That bank reserves are for just such emergencies as now exist and should be used rather than increased.

RESOLVED, That it is the duty of the trade press and the business men of this country to make every honest endeavor to find such hoarded money and bring pressure to bear upon its holders to put it back into circulation.

RESOLVED, That any bank holding more currency than its legal reserve is doing great harm to every business interest and merits no consideration whatever at the hands of merchants, manufacturers or labor.

RESOLVED, That the trade press be urged to organize business men's meetings in every city to present to the small hoarder of money a means of investing it in safe securities paying good

interest, guaranteed if need be by such association themselves.

Resolved, That money thus released be deposited only in banks that agree to put it back into legitimate channels of trade forthwith, and that manufacturing and mercantile interests be asked to do business with such banks and with them only.

Resolved, That the countermanding of orders, the closing of factories and the laying-off of thousands of wage-earners is uncalled for by any underlyiny condition of business itself, and that immediate steps to check the senseless scare is demanded of every conservative and politic American.

Wireless Telephony Before the New York Electrical Society.

An informal talk on wireless telephony by Dr. Lee DeForest at the meeting of the New York Electrical Society on Nov. 20 proved to be one of the most interesting and instructive lectures delivered before the society in recent years. Dr. DeForest, in explaining the fundamental difference between wireless telegraphy and wireless telephony as practiced to-day, stated that in telegraphy use is made of waves of steadily decreasing amplitude obtained from a spark-discharge for periods corresponding to the signals of the Morse code, while in telephony the waves are of constant frequency steadily maintained, only the amplitude being varied to correspond to the frequency of the voice tones. The "sustained" oscillations have a frequency so high that not only is the ear unable to detect them, but it is probable that the telephone receiver diaphragm cannot follow them; the frequency is never less than 20,000 cycles per second and it may reach a value of 500,000 per second. By adjusting the "natural period" of the receiving circuits, the equipment may be "tuned" to respond to the transmitting circuit having the corresponding period of "sustained" oscillations. These facts, together with the practical features of wireless telephony, were discussed on page 926 of our issue for Nov. 9, 1907.

To the labors of Duddell can be attributed the knowledge of the fact that oscillations are produced in a circuit, containing a condenser and an induction coil in series, shunted across a direct-current arc lamp. Poulsen showed that sustained frequencies as high as 1,000,000 cycles per second may be obtained by operating the arc in an atmosphere of hydrogen. It has been found that high sustained frequencies can be obtained by using compressed air around the arc, by keeping the electrodes cool artificially, or by placing the arc in the flame of an alcohol lamp. The last method is the one most easily applied, and is the one adopted by Dr. DeForest.

No satisfactory explanation has yet been offered for the production of the sustained oscillations, although the necessary conditions are well known. Thus the resistance-current characteristic of the arc is the one feature upon which the existence of phenomenon depends. Moreover, the "pinch phenomenon," as discovered by Hering and further investigated by Northrup, probably plays an important part in the production of the oscillations.

A description of the transmitting and receiving circuits employed by Dr. DeForest was given in our issue for November 9. In his talk, Dr. DeForest stated that many types of receivers are suitable for wireless telephone work. In fact, any of the self-restoring wireless telegraph receivers may be used. The crude carbon block and steel needle device is usable, but the "articulation" with it is poor; the carborundum receiver is quite good, and the electrolytic is excellent. However, the Audion receiver, especially in its latest form in which the antenna is joined to an isolated grid interposed between a tantalum filament and a platinum wing, gives perfect "articulation." (The Audion was described in our issue for Nov. 3, 1906.) The speaker mentioned also the type of detector employing a gas flame for maintaining the medium separating the electrodes in ionic activity, as noted on page 843 of our issue for Nov. 2, 1907, which gives promise of excellent results in long distance wireless telegraphy. At the present time the use of the microphone transmitter limits the talking range to less than 25 miles, but doubtless by the use of a suitable substitute for the microphone the range will be increased enormously.

Although "damped oscillations" are now commonly used in wireless telegraph communications, the excellent results obtained with "sustained oscillations" in the incidental calling telegraph signals, as used in wireless telegraphy, point to the abandonment of the spark method of producing damped oscillations in favor of some method of producing sustained oscillations. In the present telephone calling system the antenna circuit at the transmitting station is interrupted periodically by a "buzzer" device operated by a "chopper" telegraph key, and the interruptions are recorded as a loud hum in the telephone receiver.

The Right to Regulate Rates.

At Albany, N. Y., on Nov. 20, the Appellate Division, Third Department, upheld the right of the Legislature to delegate its power to fix a tariff of rates for a public service corporation to a commission. The constitutionality of the new Public Service Commission act was involved in this case. The prevailing opinion was by Presiding Justice Smith. Justices Chester and Cochrane concurred. Justice Kellogg in an opinion dissented and was concurred with by Justice Sewell. The court thus stood three to two. The appeal was from an order of the State Commission of Gas and Electricity, recently succeeded by the Public Service Commission in the Second District, fixing a maximum charge for gas and electricity within the village of Saratoga Springs. Presiding Justice Smith in his opinion referred to the brief submitted by the Public Service Commission in which he said was a quotation from the opinion given by Attorney-General Moody to Congress, in which he reaches two conclusions:

1. There is a governmental power to fix the maximum future charges of the carriers by railroads vested in the Legislatures of the States with regard to transportation exclusively within the States, and vested in Congress with regard to all other transportation.

2. Although legislative power, properly speaking, cannot be delegated, the law-making body, having enacted into the statutes the standard of charges which shall control, may intrust to an administrative body not exercising in the true sense judicial power, the duty to fix rates in conformity with that standard. In the same brief 22 States are named which have similar statutes.

"In the courts of this State this question has not been directly decided, but the principle is, I think, established in analogous cases.

"It will thus be seen that the assumption of this power by the commission is justified by convincing authority. Not a decision is cited in the State or Federal courts which questions the power provided the determination of the commissioners is directed by some standard which is presented in the statute."

Justice Smith said that "the words 'within the limits prescribed by law,' can have only one significance. The standard which is to guide this commission in the exercise of its administrative duties in fixing rates is a reasonable charge for the product of the public service corporation, one reasonable to the public and reasonable to the corporation. Such a standard is sufficiently defined within the authorities which have been referred to.

"Without these words of limitation, the act might be deemed to give to the commission the power possessed by the Legislature," continues the opinion.

"A complete answer, however, is that it cannot matter whether the standard by which the commission is to be guided be fixed by common law or by the statute. In either case no legislative discretion is delegated to the commission. Without such discretion, their functions will be held administrative and not legislative."

In discussing the reasonableness of rates, Justice Smith says in part:

"It thus appears that the stockholders of a public service corporation are not entitled to require the public to pay dividends upon fictitious stock or for their extravagance or waste. Such a corporation, however, is entitled to a fair return upon the actual value of its property that it is devoting to the public use, after paying all expenses and liabilities reasonably charged against the same. What is deemed a fair return must depend ultimately upon the judgment of the court."

In the dissenting opinion Justice Kellogg sustained the validity of commissions created by the Legislature to perform administrative duty only. The law in dispute, he holds, attempts to fix the rate as conclusive, and, therefore, to give the commission judicial powers. Justice Kellogg further held that any person or corporation engaged in a public utility business is charged with a duty and clothed with the right of rendering a reasonable service to all persons alike, and at a reasonable price, and has a legal right at any time when the reasonableness of the price is in dispute to have a determination by due process of law. Persons furnishing a public service have no legal right, he holds, to fix arbitrarily the price, and, therefore, within the powers of the State the Legislature may fix a price which is valid until determined otherwise.

He declared that it is impossible for the Legislature to fix a price which would be reasonable in every locality; therefore, it is proper to appoint a commission charged with the administrative duty of determining in the first instance what is a reasonable price. The commission, he holds, is performing only an administrative act to compel persons furnishing a service to furnish it as they have agreed. Any attempt by the Legislature or commission to compel persons to furnish a service at an unreasonable price violates property rights and deprives such persons of equal protection of law.

The validity of this statute, Justice Kellogg believed, must depend on its provisions, and the recent public service commissions law is not considered by him in assailing the old law.

Tests of Track on the Pennsylvania.

Some rather extraordinary reports in the daily newspapers recently concerning certain tests the Pennsylvania Railroad has been making on the West Jersey & Sea Shore Railroad near Clayton, N. J., have created an entirely erroneous impression. It has been stated that the company was racing steam and electric locomotives, with a view to determining the speed capability of each type. The Pennsylvania Railroad has other, more accurate and much less dangerous methods of testing the speed of locomotives than trying them out in such a manner as this.

Furthermore, the types of electric and steam locomotives which have been used in these experiments were not designed primarily for speed, and any inference based on their performance in this regard would be incorrect. What the company is doing is this: Experience indicates that the operation of electric locomotives, owing to their lower center of gravity, has an effect upon the track entirely different from that due to the action of steam engines. In order to ascertain the exact nature and extent of this pressure upon the rails the motive power department has devised the apparatus which is being utilized at Clayton.

A stretch of track about 166 ft. in length has been equipped with rails and cast steel ties, designed and made especially for this purpose. Instead of attaching the rail to the ties by spikes, a special form of block has been substituted which allows a slight movement of the rail as the engine goes over it; this movement registers the force with which the flanges of the wheels strike or press against the rails. It is expected that a large number of experiments with this apparatus will show the company quite accurately what the effect is of either steam or electric locomotives moving at different speeds over either straight or curved track.

Necessarily, to make these tests, the engines must move at different speeds, and at all times each attains its maximum speed. An electric apparatus has been devised to measure the precise amount of time elapsing while the different locomotives pass over this 166 ft. of track, in order that in computing the effect upon the track the exact speed attained may be known. The steam and electric locomotives, however, go over the track at different times, and there is no element of contest as to speed between the two types. The matter of speed is purely incidental to the main purpose of the tests, which is to enable the company, in planning its electric installations in New York, to design a track so safe as to be absolutely secure against any form of locomotive that may be utilized.

Cleveland Branch of A. I. E. E.

The first regular meeting of the Cleveland branch of the American Institute of Electrical Engineers was held in the Electrical Building, Case School of Applied Science, Nov. 18. After completing a few details of organization which were left open at a former meeting, the subject of the evening, "Industrial Applications of the Electrical Motor," was taken up. Mr. J. R. Wilson read a paper on motors, both of the direct-current and alternating-current type. For many uses, he said, the best results have been obtained from direct-current motors, although alternating-current machines are perhaps better adapted to long-distance work. The standard voltage for both systems is 230 volts. For operating groups of machines, Mr. Wilson stated that the shunt wound motor is best fitted, though under certain circumstances the compound motor may be used to better advantage. High-speed machines should not be used for group work.

Passing over the multi-speed motor, which has not come into general use, the speaker said there are many adjustable speed machines on the market, of which the single-voltage weakening field type is perhaps the more generally used. The advantages and objections to this type of motor were discussed in detail, as were the means of obtaining adjustable speeds. The speaker said that he had seen 230-volt motors reversed at 600 amperes without making a spark.

Mr. J. C. Lincoln discussed variable speed motors for the operation of machine tools, and incidentally stated that they are better adapted to rotary tools than any other kind of power. He illustrated his point by a number of experiences and gave examples of speeds at which economy is reached in operation. He discussed the manner of securing variable speed, such as varying the flux, varying the air-gap reluctance and one or two other modes. The use of the commutating pole, he said, has made possible many pieces of apparatus that would not otherwise have come into existence. Mr. Lincoln said that the first patent on the commutating pole was issued to Richard Mather in 1884 and was used in the Mather motor, which is now a thing of the past. Repairs on the commutators, he said, are greater, however, on field weakening systems than on the multivoltage systems.

The method of control of motors was discussed by Mr. R. I. Wright, who illustrated his ideas by means of curves, the result of experiments. The subject of central station power was discussed by Mr. Mark Knabenschue, who is connected with a large central station company. The speaker said he believed that energy can be furnished cheaper by a large company than by an isolated plant. Fuel can be secured at a lower price usually and the investment is not as costly in proportion to the power furnished. In the central station one man is required for each 1000 horse-power, while in an isolated plant two men are usually employed for each 100 horse-power. The cost of an isolated plant is figured at about 5 per cent interest, while a manufacturer always counts on making at least 20 per cent on his money. If he can do this his investment is worth more in his business than in an electric plant. Space is also valuable in and about all manufacturing plants and may be utilized to better advantage in the business than for a plant. Consider-

able attention has been given to gas engines for driving small stations, he said, and in some cases they have given satisfaction. The depreciation is usually heavy, however. Central station supply is reliable and is better for motors, as there is no danger of overloading. It is valuable for a growing plant from the fact that power stations do not have to be enlarged to allow of putting in new machines or making additions.

Mr. A. M. Allen discussed the size and application of motors for various purposes. He said that very often motors selected are too small for the work for which they are intended. Manufacturers should give more information about their product, so that engineers may understand just what they are doing when installing plants. Printed lists are often misleading, because they do not go into detail. Every little point should be taken into consideration in the selection of a motor. A machine that will do a certain work in one place will often not perform the same work in another, because the conditions are different. A motor should always be chosen that will operate a machine to its maximum efficiency. The speaker discussed the importance of a balance wheel for motors that operate with intermittent loads. He said it is easy to equip a plant where the load is constant, but when not then the question is a different one. Occasionally it is necessary to connect a test motor with the load and then by a careful reading of the wattmeter the size of the flywheel may be determined. Poor attention and bad management often cause failure in modern plants designed by good engineers. Alternating-current systems are more simple and require less attention than the direct-current, but the power factor must be considered in all installations.

Mr. Herkner gave an interesting talk on the automobile motor and the types best adapted to the machines. Various combinations of designs were illustrated and explained. The kind of motor and the power depends to a great degree upon the tires to be used and other peculiarities of the automobile. Batteries, electric braking, speed and application of power were all discussed at length.

Mr. Dusenberre insisted that more data should be given regarding motors in order that they may be adapted to application in certain uses. Heat limits and ultimate commutation limits should be made known, he said. Mr. Ricker spoke of the use of alternating-current induction motors for coal and ash handling, because they will stand the dust and rough usage.

Electrical Equipment of the Steamship Mauretania.

Although interest in the new turbine-driven quadruple-screw Cunarder *Mauretania,* which has just made her first trip to this country, naturally centers in the dimensions and capabilities of the craft, the completeness of her electrical equipment and the various applications of electricity on board are worthy of mention.

Before entering on the latter subject it will not be without interest to note the principal data of the ship. The length of the vessel is 790 ft.; beam, 88 ft.; draft, 33.5 ft.; displacement, 38,000 tons. The boilers contain 192 furnaces with an aggregate grate area of 4060 sq. ft., consuming about 50 tons of coal per hour. The horse-power is 68,000. There are four three-bladed propellers, the shaft of each of the two inner ones having a low-pressure Parsons turbine, and the outer shafts each a high-pressure turbine. The inner shafts are in addition each fitted with a high-pressure turbine for backing. The steam pressure is 195 pounds. Aside from the sister ship, *Lusitania,* the next largest vessels now afloat are the North German Lloyd *Kronprincessin Cecelie,* finished the present year, with a displacement of 27,000 tons, and 45,000 hp; the North German Lloyd *Kaiser Wilhelm II.,* finished in 1903, with a displacement of 26,000 tons, and 40,000 hp; and the Hamburg liner *Deutschland,* finished in 1900, with a displacement of 23,620 tons and 36,000 hp. These three vessels have quadruple-expansion reciprocating engines.

Besides having the distinction of being the largest and fastest ocean steamship yet built, the *Mauretania* also has the distinction of possessing the largest electrical plant afloat. From the outset it had been intended that everything that could be operated electrically would be done so, and this has been carried out quite extensively. The turbo-generator sets, of which there are four, are placed in two rooms abaft the main turbine rooms. The rooms are separated by a watertight bulkhead and each room possesses besides two 115-volt, 375-kw turbo-generators, a switchboard for controlling the circuits on its side of the boat. The boards may be connected in parallel by means of a connecting bar and switch.

From the port and starboard switchboards main cables run direct to various distribution boards, and each board is connected to the corresponding board on the opposite side of the ship. The cables are laid as far as possible below the waterline on the side of the ship and carried between porcelain insulators, the positive cables on one frame and the negative cables on another. The switchboards are similar, each consisting of two generator panels, 12 feeder panels and one disconnecting panel. Each generator is connected to a maximum reverse-current and time-limit relay, while each feeder is equipped with a maximum-current, time-limit relay.

The turbo-generators have a normal rating of 375 kilowatts when working against a back pressure of 10 pounds, so that nearly double the output can be obtained when the turbines are operating condensing; auxiliary condensers being installed for that purpose. The speed of each unit is 1200 r. p. m. and the generators present some interesting points in design owing to the heavy current developed (nearly 4000 amperes) and the restricted length and diameter of the commutator. The latter is cooled by a ventilating trough, the mouth of which is brought under the commutator.

The illumination, despite the fact that over 5000 incandescent lamps are in use, requires only a small portion of the energy generated. Many of the staterooms seem to have been designed to show to greatest advantage with the electric light. They are fitted, for instance, with glass domes and between these and the ordinary skylights are placed several incandescent lamps, which at night give to the rooms a magnificent appearance. There is, of course, a considerable difference between the types of fittings found in various parts of the boat, the most luxurious being placed in the suites, dining saloons, library, ladies' boudoir, etc., occupied by the passengers. Perhaps one of the most beautiful lighting effects is that seen in the dining room for first-class passengers. Here the dome is decorated in white and gold and around its base are arranged numerous incandescent lamps which have their rays directed on the ceiling whence they are reflected to the tables beneath. Not a lamp is visible, and the soft glow at night is very pleasing. Electric radiators, portable reading lamps, and such luxuries as curling-iron heaters, cigar lighters and fans are to be found in the staterooms.

The chief demand for energy and the most constant one comes from the fans for producing the forced draught for the boiler furnaces. For each of the four stokeholds there are two fan rooms directly over the boilers they operate, each being well ventilated by a 5-hp series motor. In each fan room there are two separate fan motors independently wired, each motor driving two fans. The fans take air directly from the top of the boilers, so that it is already heated before being delivered into the furnaces. The motors driving these fans are shunt-wound and rated at 50 horse-power. They are fully enclosed, but ventilated by a small fan on the same shaft and connected to the motor by an air duct. The motors thus run cool and are protected from dust and dirt. They are controlled from the stokehold by levers which operate the controller handle in the fan room. There are 16 motors with a maximum aggregate rating of 800 horse-power used for this service.

Electricity also plays an important part in the cooling and heating of the saloons and berths. There are 60 thermo tanks distributed about the ship and in each of these is a motor-driven fan which forces the hot or cold air into the distributing trough. The motors vary in size averaging from 3 to 8 horse-

power in output. For ventilating various other parts of the ship, such as the turbine rooms, 30 motor-driven fans, ranging in output from 5 to 10 horse-power, are used.

For ease in dismantling the turbines for repairs, six sets of lifting gear are provided, each set being operated by a 30-hp motor capable of taking double load at starting. There are also four 12-hp motors for operating the sluice valves, the controllers for operating which are placed inside the starting pedestal.

For unloading and loading baggage, four electric cranes, each capable of lifting over half a ton, are installed. When hoisting they travel at 200 ft. per minute, when turning they operate at 300 ft. per minute, the lift being 40 feet and the swinging radius 24 ft. for two of the cranes and 18 ft. for the other two. Electric hoists are, of course, used and these are operated on the push-button, relay principle. The passenger elevators are equipped with an electromechanical brake which automatically operates as soon as the electric circuit is opened and releases again as soon as the circuit is closed. The operator's handle is fitted with a spring so that if the hand is released the handle automatically returns to the "off" position and opens the circuit.

Motor-driven cargo winches are used, as well as four electric boat hoists. The latter are operated by 14-hp, series-wound motors. For the preservation of perishable cargo two refrigerating units are installed on the orlop deck aft of the forward funnel. Each unit is driven by a 35-hp shunt-wound motor. The brine pumps are driven by 3½-hp motors particularly silent in their running.

For minor purposes the applications of electricity are numerous. Knife cleaning and sharpening machines are to be found in abundance, as are boot-cleaning machines, ham slicers, bread cutters, etc. There are three large electric grills and various motor-driven roasters in the kitchen, as well as electric dish washers, plate warmers, vegetable peelers; in fact, every conceivable operation that can be mechanically carried out is done so by electric motors.

Passengers occupying the best cabins have all the telephone facilities of a modern hotel. A complete central energy system is installed and when in port this system is connected with the land exchanges on the moment of arrival and up to the time of sailing. The switchboard is capable of operating 200 stations and 20 exchange lines. For connection to the shore 10 pairs are run from the switchboard to a box on each side of the ship. Several similar boxes are placed on the dock or landing stages and a cable connects them.

Two interesting applications of electricity are found in the torsion meter for measuring the power developed in the propeller shafts, and in the electric whistle operator and telegraph for sounding the whistle at definite intervals. The ship is also equipped with a complete wireless telegraph outfit.

George Washington University College of Engineering.

Although it is only three years old, the College of Engineering of the George Washington University, at Washington, D. C., is worthy of the attention of the electrical world. Its connection with the university and its command of the governmental machinery for research give it two advantages that perhaps no other institution of the kind in this country enjoys. Each year is certain to see its usefulness grow. Prof. Howard Lincoln Hodgkins, dean of the department, is enthusiastic over the steady growth in attendance. This has been regular ever since the College of Engineering was established in 1905. "The student body has grown 10 per cent each year in the three years of our existence," he said, "and we have an attendance now of 150 students. Just as soon as the advantages we are enabled to offer students in this city become known, I fully expect our present accommodations will be too inadequate to care for those who will want to matriculate. We are especially well situated. Among the many departments of the government open to our students is the Bureau of Standards, which boasts of the finest equipment for pure science investigation to be found in the United States. Two of the investigators there are members of our faculty; they are the chief physicist, Dr. Edward B. Rosa, who is one of our professors of physics, and Dr. Frank A. Wolff, professor electrical engineering.

"Only a day or so ago the chief electrician of the Navy Yard called upon me to offer the facilities of the yard in his line to our students. The fact that another member of the university faculty, Prof. N. Monroe Hopkins, is chief of the electrical division of yards and docks of the Navy Department, insures our students still another field rich in opportunity for original research."

This spirit of co-operation with the college shown by government officials is one reason why the institution has already taken its place in the front ranks. An added reason is found in the comprehensive curriculum laid down for the students. In connection with his technical training, he is educated along other lines necessary to turn out a graduate who will be an honor to his profession and to his alma mater. According to the university catalogue: "The courses in engineering are planned to give the student a thorough understanding of the theory underlying engineering practice, and such a practical knowledge of the instruments and methods of his particular profession as will enable him to apply the theory properly. In all the courses a thorough training in mathematics, pure and applied, and in drawing and descriptive geometry is required as the basis of the analytical and graphical study of engineering topics. Much stress is laid on the work in the drawing-room and laboratory. The work is planned to give him a thorough knowledge of principles on which he may build, and by which he may be able to solve the new problems he meets in practice.

"The work of the first year is the same for all students. It is taken up partly with general studies, which have both an educational and a cultural value, and partly with work in mathematics and drawing, which lays the foundations for subsequent courses. In each of the other years there are studies taken in common by all engineering students, these studies including courses in English, in French, and in German, in pure and applied mathematics, in drawing and descriptive geometry, in chemistry and in physics. The requirement in French and German is intended to give the students an accurate reading knowledge of these languages, with particular reference to scientific literature.

"The electrical students begin their special work in electricity in their junior year. Theoretical electricity is first studied, and is followed by engineering electricity and by courses on direct-current machinery. In the laboratory, experimental work in exact measurements is followed by the study of the dynamo. In the drawing-room are studied related problems in design. In the senior year alternating-current machinery is studied, both theoretically and practically; and courses on the application of electricity and on light and power distribution are taken. Many hours are given to work in the electrical and general engineering laboratories."

It will be seen from this that the electrical engineering course is laid down with thoroughness. It is destined to turn out men who, living up to the requirements, cannot fail to grace the profession. In connection with the course mapped out, the College of Engineering is well equipped, physically, to carry it out.

This department of the George Washington University found it necessary during the current year to provide larger quarters for its students. Two buildings were leased, a couple of city blocks distant from the main university buildings, and have been arranged for class room and drawing-room work. Provisions also have been made in these buildings for offices for all the instructors, and this has been found of great advantage. The students are under better supervision, and at all hours several instructors are on hand to give assistance and information whenever it is needed. These two buildings, which have been thrown into one, provide class-rooms, social rooms for

the students, offices for the members of the faculty, and space for the college's excellent library.

All of the laboratories are at University Hall, in the main building. Because of the necessity for being near apparatus used in illustrating lectures, practically all the classes in electrical engineering meet in the physics room and the adjoining room in University Hall. The laboratory work in physics and in electrical measurements is done in the physics room and in two rooms adjoining.

Immediately off the physics room is the dynamo hall. In this hall is an excellent equipment of dynamos and motors, most of which are modern machines, presented to the university two years ago by Mr. Westinghouse, and selected with especial reference to their adaptability for experimental work. The college is looking forward to adding a number of ammeters, voltmeters and wattmeters, and when these are installed it will be able to give, in a very thorough manner, all of the usual dynamo and motor tests.

In a room under the mechanical laboratory has been installed a 25-kw Westinghouse dynamo, directly connected to a Westinghouse gas engine. This dynamo was especially constructed so that it might be adapted to experimental requirements, for it generates both direct and polyphase alternating currents. The engine is a two-cylinder, single-acting machine, giving an explosion every revolution, with an exceptionally close regulation. In addition to this engine, there is another one in the battery which also is well adapted for experimental work.

Between the mechanical laboratory and the law building is installed the steam laboratory, which is also used as a room for shop work. There are work benches for such students as care to pursue studies in bench work, both in wood and metal. The shop is equipped with lathes, jig and circular saws, planers and drill presses. Power for this machinery is supplied by a motor. In addition to this equipment, there is a 40-hp boiler, which supplies power for a high-speed Shepherd engine and for a horizontal Armington & Sims engine. A dynamo and water rheostat and a Prony drag furnish load for this engine. There is also a modern De la Vergne refrigerator machine, which is to be used for experimental tests and demonstrations in connection with regular class work in the course of compression and refrigeration machinery.

The teaching staff of the college is exceptionally efficient. Aside from the many government experts who aid in the work of the department, the force of instructors in technical engineering subjects now consists of seven men giving their entire time to the work. One of these instructors is a graduate of the university; one is a graduate in civil engineering of Dartmouth; two are graduates of the Massachusetts Institute of Technology; one is a graduate of Rutgers College; one a graduate of Cornell University, and one a graduate in mechanical engineering of Columbia University. Three of these men joined the faculty this year. However, these seven men do not constitute the full force of the College of Engineering, by any means. Students of the college take, in common with the other students of the university, the general subjects of mathematics, English, languages and sciences, so that the faculty of engineering, therefore, may be correctly stated as containing 27 officers of instruction.

The personnel of the board of trustees insures the success of this especial department of the George Washington University. The trustees are: Charles W. Needham, president of university, ex-officio member of the board; Thomas W. Chatard, mining engineer; Bernard R. Green, superintendent, Congressional Library; John B. Larner, attorney at law; Frederick H. Newell, director, United States Reclamation Service; T. Commerford Martin, editor of Electrical World; Admiral Charles W. Rae, engineer-in-chief, United States Navy; Samuel W. Stratton, director, United States Bureau of Standards, and Otto H. Tittmann, superintendent, United States Coast Survey.

Altogether, this school seems destined to attract more and more attention as it adds years to a record that is so auspiciously begun. It has all the natural advantages for an institution of its kind. Its chief need is encouragement in a financial sense or through donations by liberal-minded men in the electrical field of machinery and apparatus necessary for the thorough drilling of its students.

CURRENT NEWS AND NOTES.

TECHNICAL PUBLICITY ASSOCIATION.—The Technical Publicity Association held its November meeting on the evening of the 21st, in New York, and listened to an address on "The Evolution of Fine Printing and Its Influence on Advertising Literature," by Paul Pfizenmayer. As usual, new members were elected.

NORTH CAROLINA TRANSMISSION PLANT.—Work is now in progress on a 60,000-volt, 120-mile transmission plant from Blewett Falls, N. C. Electrical power will be supplied to cotton mills, central stations, etc., extending in one direction to Hartsville, S. C., and in another direction to Wilmington, N. C. Lockwood, Green & Company, of Boston, are the designing and constructing engineers.

SOUTHERN TELEPHONE REBATES.—Vice-President W. T. Gentry, of the Southern Bell Telephone & Telegraph Company, announces that after the first of January all rebates for telephones will be abolished in Savannah, Ga. The giving of rebates in Savannah and many other Southern towns is explained as having been a necessary evil heretofore in meeting competition from independent companies.

A. I. E. E. MEETING.—The next meeting of the American Institute of Electrical Engineers will be held in the auditorium of the Engineering Societies Building, 33 West Thirty-ninth Street, New York City, on Friday, Dec. 13, at 8 p. m. Mr. Walter S. Finlay, Jr., of the Interborough Rapid Transit Company, will present a paper on "The Ratio of Heating Surface to Grate Surface as a Factor in Power Plant Design."

TELEPHONE COMPETITION.—At Hartford, Conn., on Nov. 25, the subject of telephone competition was discussed at length by the members of the National Grange, and the body went on record as favoring open competition. A resolution was passed calling upon the members of the different organized bodies of the Grange, "members of the Legislature in the different States, members of the House of Representatives and Senate in Congress convened, and the President of the United States, to use their best endeavors to allow free competition."

NEW STOCK OF RADIUM.—A despatch from Vienna dated Nov. 22 states that the Academy of Science has just made the largest quantity of radium yet produced—46 grains. Ten tons of uranium and pitchblende, given to the Academy by the Government from its mines in Bohemia, were used in its production. Its extraction cost $10,000. The Academy will present a small fraction of the radium to Sir William Ramsay, the well-known English scientist, for experimental purposes. It will use part of it to test Prof. Ramsay's theory regarding the convertion of radium into other elements.

INSTITUTE YEAR BOOK.—Secretary Pope has just issued the year book of the American Institute of Electrical Engineers, a substantial publication of 244 pages, making the first volumes of complete transactions look slim. It contains a list of officers and committees, a catalogue of members, the constitution, standardization rules, etc. The catalogue of membership, as of Aug. 1, occupies 180 pages and includes 4861 names. The actual list is now about 5200. Of 19 past presidents all but two are living, and of 63 past vice-presidents all but five are surviving. There are only two honorary members, Lord Kelvin and Sir W. H. Reece. A few other Europeans would not be amiss outside of England. The institute now has 19 local or sectional organizations, and 17 university branches, with six local honorary secretaries in New South Wales, South Australia, Canada, Mexico, West Indies and England.

LIQUOR OR LIGHT.—A special dispatch from Hudson, Ohio, of Nov. 14, says: "If the village of Hudson will bar liquor for 50 years, with the exception of beer, which the donor is willing to let the villagers imbibe, $75,000 will be forthcoming for an electric light and sewerage system. This offer has been made to the village council over the signature 'Hudson Citizen.' Although none is breathing it aloud, the name of the donor is understood to be Jas. W. Ellsworth, millionaire coal operator, retired."

TRANS-CONTINENTAL WIRELESS TELEGRAPHY.—The Pacific Wireless Telegraph Company, the home office of which is at 805 Union Trust Building, Los Angeles, Cal., has announced its intention of establishing a chain of land stations from San Francisco to New York. The company has as yet not selected a site for the New York station, but it has installed equipments at Santa Catalina Island, San Pedro and Los Angeles, Cal.. Fort Casey, Port Townsend, San Juan Island and Seattle, Wash., Victoria, B. C., and Chicago, Ill.

CARNEGIE A SEPTUAGENARIAN.—Mr. Andrew Carnegie celebrated the seventieth anniversary of his birth on Nov. 25. The day found him hale and hearty and playing an 18-hole round of golf at the St. Andrews links. When asked for some appropriate reflections, he said: "The world is growing better. I find improvement in every case. Men are more kindly disposed, more charitable, more solicitous for others, less selfish. The outlook of men is broadening everywhere. Their capacity of sympathy is expanding; their sense of duty to others and responsibility for others is growing more acute. Man becomes more and more his brother's keeper." The Engineers' Club is to celebrate Mr. Carnegie's birthday with a banquet on Dec. 9, when he will be the guest of honor in the new house. It will be a memorable occasion, and John Fritz and Mark Twain are to speak.

EDISON ON WIRELESS.—In a recent *New York Times* interview in regard to its pages of foreign news received from Europe by wireless telegraphy, Mr. Edison said last week: "This thing is in its infancy yet. It is easy to see that. This young fellow Marconi does not know a tenth part now of the possibilities of wireless that he will learn in the next 10 years. The possibilities of the thing are limitless. The obstacles in the way now can easily be overcome. As for a ship getting out in the ocean and taking off the messages from the current, or another man setting up his apparatus and interfering with the connection, these things can be prohibited by law. You know that a great invention was never perfected in less than seven years. When a man has made his discovery he has just begun. Then he has to work for years and years before he has the thing anywhere near completed."

DR. STEINMETZ LECTURES ON RADIATION.—On Thursday evening, Nov. 21, at 8 p. m., Dr. Steinmetz delivered at the Polytechnic Institute of Brooklyn one of the most instructive and interesting lectures which he has ever given. The topic of the lecture was the "Physiological Effects of Radiation; Visible, Infra-red, Ultra-violet, and X-radiation." This lecture is the second of a series of popular evening lectures on the subject of radiation, light and illumination which Dr. Steinmetz will deliver at the Brooklyn Polytechnic. The lecture was beautifully illustrated with striking experiments performed with silicon, the mercury-vapor arc, and with an iron arc operating under a high-frequency condenser discharge. The subjects of radiation, reflection, refraction, absorption, fluorescence and phosphorescence were gone into in Dr. Steinmetz's customary thorough manner. The lecture was well attended and great interest prevailed.

DATA ON SELENIUM.—A note on selenium, prepared by Frank L. Hess, geologist, is published in an advance chapter from "Mineral Resources of the United States, Calendar Year 1906," where the production of antimony, arsenic and bismuth in 1906 is also reported. At present the metal selenium is variously quoted at from $13.33 per kilogram (2.2046 pounds) to $2 per ounce, as there is no steady market and the prices vary with different dealers. No selenium is known to be produced commercially in this country, but during 1906 one copper refinery made some in an experimental way, and it is possible that it was produced at other refineries also. At this refinery the selenium was obtained from the anode slimes or mud, where it is left with gold, silver, and other residues in the electrolytic refining of copper. Minerals containing selenium are of rare occurrence in the United States, but a demand for the metal due to electrical development could probably be supplied by utilizing the small quantities found in the copper-refinery slimes.

GOVERNMENT TELEGRAPHS.—A recent economic writer discusses the British state telegraphs in a very pessimistic manner. None of the forecasts of the earning power of the system appear to have been realized. The operating expenses exceed on the average 92 per cent of the gross earnings. The annual telegraph deficits aggregate 25.5 per cent of the capital invested. One of the worst features of the existing systems is the pressure of employees upon the House of Commons for increased wages and salaries. The civil service unions curtail the power of the government to dismiss incompetent and redundant employees. To make matters still worse the House of Commons curtails the executive power to promote employees according to merit, and intervenes on behalf of the public servants who have been disciplined. The advantage of the civil service is less in evidence than one would suppose. The author considers that the House of Commons represents extravagance and not good management. The case is summed up thus: "The nationalization of the telegraphs has corrupted British politics by giving a great impetus to the insiduous practice of class bribery. It also has placed heavy burdens upon the taxpayers. But that is not all. The public ownership of the telegraphs has resulted in the state deliberately hampering the development of the telephone industry."

CHICAGO EDISON MERGER.—An opinion has been filed by the assistant corporation counsel of Chicago, and accepted by the city electric light committee, declaring that the recent consolidation of the Edison and Commonwealth companies was legal. This will require the Commonwealth-Edison company to operate under the Commonwealth ordinance, and takes in the entire city, while the old Edison ordinance covered only a part. Besides, it is a long-term grant, running for 50 years, while the Edison grant expires within five years. It carries a provision that 3 per cent of the gross receipts shall go to the city. On receipt of the opinion the committee at once ordered the corporation counsel to prepare an ordinance acknowledging the validity of the consolidation and requiring that the new company, on its passage, pay 3 per cent of the entire gross receipts of the two former companies to the city. This will make a total of something over $225,000 a year from the consolidated company. But last year the Commonwealth company paid a little more than $75,000, so that the gain will come from the added $150,000 from the Edison Company's business. The Edison Company's franchise covers the territory bounded by the lake, Thirty-Ninth Street, Western and Fullerton Avenues. Its gross receipts last year were $4,744,823, but the city got nothing of it. The Commonwealth covers not only this territory but all of the rest of the city, but before the consolidation was operating only in the outside districts. Its gross receipts were $2,507,772. Of this the city got 3 per cent. In addition to holding the consolidation valid, the Miller opinion holds that the electric company can cut rates in parts of the city to meet real competition, while not making the same cut in others; that the test of a reasonable rate is not whether there is a fair profit on each individual account, but on the business as a whole; that the city has the right to regulate the rates so as to make them reasonable, and that the Commonwealth Company is entitled to mortgage its franchise for the sale of bonds.

WIRELESS TELEPHONY.—A cable dispatch from Berlin, Germany, of Nov. 11, says: "A German company is now telephoning wirelessly from Nauen to various places in Germany, 50 to 60 miles distant. One of the managers of the company said to-day that conversations had been conducted with extreme clearness and precision."

STEAM TURBINES.—At a meeting of the New York Electrical Society, to be held on Dec. 18, in the Engineering Societies Building, Mr. H. H. Barnes, Jr., will deliver a lecture dealing with the present status of the steam turbine. This will be an illustrated lecture, and will be most valuable in its data as to the condition of the art.

CONTROL OF CORPORATIONS.—The Georgia State Railroad Commission is to issue an order requiring all the gas and electric light companies of the state to report to it respecting the details of their business, including charges for depreciation, physical condition of the works, etc. The plan for the reporting is along the lines of the tabulation put out for the Southern Bell Telephone System.

ELECTRIC LIGHTING COMPLAINTS.—On Nov. 18, at an open meeting, the New York Public Service Commission passed a rule concerning the filing of complaints against gas and electric lighting companies. Complaints must be signed by not less than 100 customers, and no single complaint shall include both gas and electricity; they must be kept separate. Upon such complaint being filed the commission may order a hearing, not only on the matters contained in the complaint, but on such other matters as it deems advisable.

MORE SUBMARINES FOR THE NAVY.—The Navy Department on Nov. 16, according to a Washington despatch, executed contracts with the Electric Boat Company of New York for the construction of seven submarine torpedo boats, aggregating in cost $2,270,000. Some of the boats are to be of the same size and types as the Octopus, which won the competition at Newport last spring, and others are to be of the same type, but larger and of greater speed. The construction of the boats is to be started at once, the work being done at the yards of the Fore River Shipbuilding Company, at Quincy, Mass.

STREET RAILWAY ACCIDENTS.—The Public Service Commission has given out a record of the street railway accidents in New York during October. Forty-seven persons were killed last month in street car accidents in this city according to the reports made to the Commission. This is a decrease from the number killed during September. It is thought to be due to the fact that the closed street cars have been put on in place of the open cars, to which there are several exits and in the operation of which there are consequently more chances of accidents. The total number of accidents recorded for the month was 4866 as against 5202 for September, and 5500 for the last 26 days of August. The total number of serious injuries inflicted, including the fatal cases, is given as 191 for the month, as against 216 for September and 189 for August.

X-RAY TEST OF DEATH.—Advices from Paris state that according to a report of Dr. Vaillant of the Lariboisière Hospital, presented at the Academy of Science last week, all danger of burial alive has been removed by the use of X-rays. Dr. Vaillant has discovered that, after numerous experiments with radiographs, the living and the dead present numerous differences. In the radiograph of a living person the viscera is invisible and the abdominal organs are in constant movement, and so leave no trace on the photographic plate. In the radiograph of a dead person, on the contrary, the stomach and intestines are clearly marked—this being the case even when the radiograph is taken only a few minutes after death. Dr. Bordas, whose experiments with radium on the color of precious stones attracted so much attention, recently made a report to the same session of the Academy in which he showed that practically the same results could be secured by submitting the gems to the influence of the X-rays. In the presence of the assembled scientists, a pale ruby was placed under a Crooke's tube; 40 minutes later it was found to be a dark, brilliant red and greatly enhanced in value.

THE NIMBLE NICKEL.—During the late financial panic in a Western city, remote from dreadful Wall Street, and where the troubles were therefore of purely local origin, the street railway company could not collect fares, owing to the shortage of cash, and issued promissory slips, punched for each ride, to be paid for later. Last week, the Omaha Street Railway Company flooded Omaha with nickels by meeting its monthly payroll with 600,000 five-cent pieces, $30,000 in all. Ever since the money stringency the street railway promised its employees actual cash on pay day, and to this end had been holding the daily receipts of nickels. When the men lined up for their pay, it was handed them in neat little packages of 20 nickels each. By paying out the nickels the street-car company made change plentiful around town. Most of the nickels went right back into circulation through the shops.

SLY MUNICIPAL POLITICS.—In an article on juggled city payrolls, referred to as in the above caption, the *New York Tribune,* otherwise an advocate of municipal ownership, lays bare a great scheme of graft and fraud, and says: "In both the Bronx and Manhattan there has been a great deal of mysterious juggling with payrolls, and thousands of workmen are employed year in and year out in repairing park roadways and boulevards whose wages are paid out of money raised through the sale of corporate city stock. There are also a large number of salaried officials who have been paid for years out of budget appropriations for maintenance, so that their names have never appeared at all in the annual statement of accounts. Much of the increase of $420,000 in next year's budget over this had to be voted in order to provide for the salaries of these officials in the regular budget appropriation for salaries. This was one of the results of the investigation ordered by the Comptroller. But even now there is a staff of some 60 or 70 permanently employed engineers who have been in the service of the Park Department for years whose names do not appear upon any salary list provided for in the budget. They are paid out of various corporate stock funds, and their salaries are carried from one account to another year after year."

TELEPHONE THEN TRAVEL.—One of the favorite telephone catch phrases has been: "Don't travel, telephone." Now we have a variation that may become just as popular. Tickets and Pullman accommodations on the New York Central lines can be obtained by telephone or letter, under a plan just inaugurated by F. L. Vosburgh, general Eastern passenger agent. By this arrangement anyone can obtain tickets by a messenger, who is authorized to collect for them and complete any other arrangements necessary for the comfort of the traveler. At each of the New York City offices of the Vanderbilt lines these messengers will be constantly on duty, making possible hasty preparations for travel at any hour of the day. Although New York is the best equipped city in the world for the accommodation of the traveling public, offices of the various roads being located in all parts of the business district, Mr. Vosburgh says he has found that many persons who at times are hastily called away need still further aid in preparing for their trips. "We have inaugurated the plan to accommodate the busy traveler, and believe that the increased business will merit keeping it in operation," Mr. Vosburgh said. "There are many persons who find it necessary to arrange for their accommodations in their home, hotel, club or office. We have competent representatives, who on the receipt of a note or telephone call will be sent to the prospective traveler's residence or office. He will take with him the necessary tickets and Pullman accommodations, collect for them and make all other necessary arrangements for the comfort of the traveler."

Transmission System and Sub-Stations of the Dunedin City Corporation, New Zealand.

LAST week's issue contained an illustrated description of the hydro-electric generating station erected on the Waipori River for the Dunedin City Corporation. Electrical energy from this station is transmitted to a sub-station in Cumberland Street, Dunedin, through an intermediate sub-station at Halfway Bush. The distance from the power-house to Halfway Bush is about 28 miles and the total distance to Dunedin is approximately 30 miles. It is the purpose of the present article to describe the transmission system and sub-stations.

TRANSMISSION LINE.

After leaving the power-house the high-tension transmission line runs to sub-station No. 2, located about 21 miles from the power-house. This sub-station is situated on the Taieri Plains in order to meet the conditions demanded by the Taieri County Council for granting the right to the Dunedin Council to take the transmission lines along the roads within the Taieri County. The nature of the agreement is that so soon as the Dunedin Council has contracted for a demand that will take four-fifths of the maximum output of the station, the remaining fifth may be utilized for the benefit of the residents of Taieri County at a rate not exceeding that given to the most favored consumer in the City of Dunedin under like conditions of supply. In this sub-station the connections are so arranged that the transmission lines may be inter-connected in any manner. There will also be a bank of transformers for reducing the pressure to 3300 volts for distribution in the neighborhood. About 1½ miles from this sub-station is the town of Mosgiel, where there is a large woolen factory and several mills, which eventually will, no doubt, be connected to the system.

When fixing the route for a transmission line, special consideration must be given to the character of the country facilities for patroling, climatic conditions and the voltage. The voltage, of course, depends upon the distance, the price of copper and the limit of line loss. The question of good regulation practically governs the latter, and after careful consideration a voltage of 35,000 was adopted as being reasonable for insulation and economical as regards weight of copper in the line. The transmission line is in duplicate throughout, and each line is entirely independent of the other.

The site of the power station is 436 ft. above sea level, and the hills forming the banks of the river have an angular slope ranging from 30 degs. to almost vertical. These hills are covered with dense bush to about 1000 ft. above sea level, and as it would have been a very expensive matter to construct the transmission line on the slopes of the hills the route chosen was across the top of the divide between the power station and the Taieri Plains.

On the opposite bank of the river to the power station there is a small plateau, and then the hill rises with an average angle of about 40 degs. to a height of 1095 ft. above the sea level, and thence the country gradually rises to an elevation of 2000 ft. above sea level. At this altitude there is a fairly level tableland, which is about two miles across, and then the mountain, which is known as Maungatua, slopes towards the Taieri Plains with a series of sharp spurs. The country on the top of the mountain is entirely open, and mostly used for grazing purposes. In winter it is exposed to severe southwesterly winds and is covered for days with snow. This route was chosen as being the most direct to the Taieri Plains, and at the same time because of the ease of construction for the line and facility of patrolling.

The transmission lines leave the power station at the top of the lightning arrester annex, the wires passing through fibre tubes held in glass shields. From this point the wires are taken to a terminal tower on a spur about 80 ft. above and at the back of the power station. From this tower the wires span the

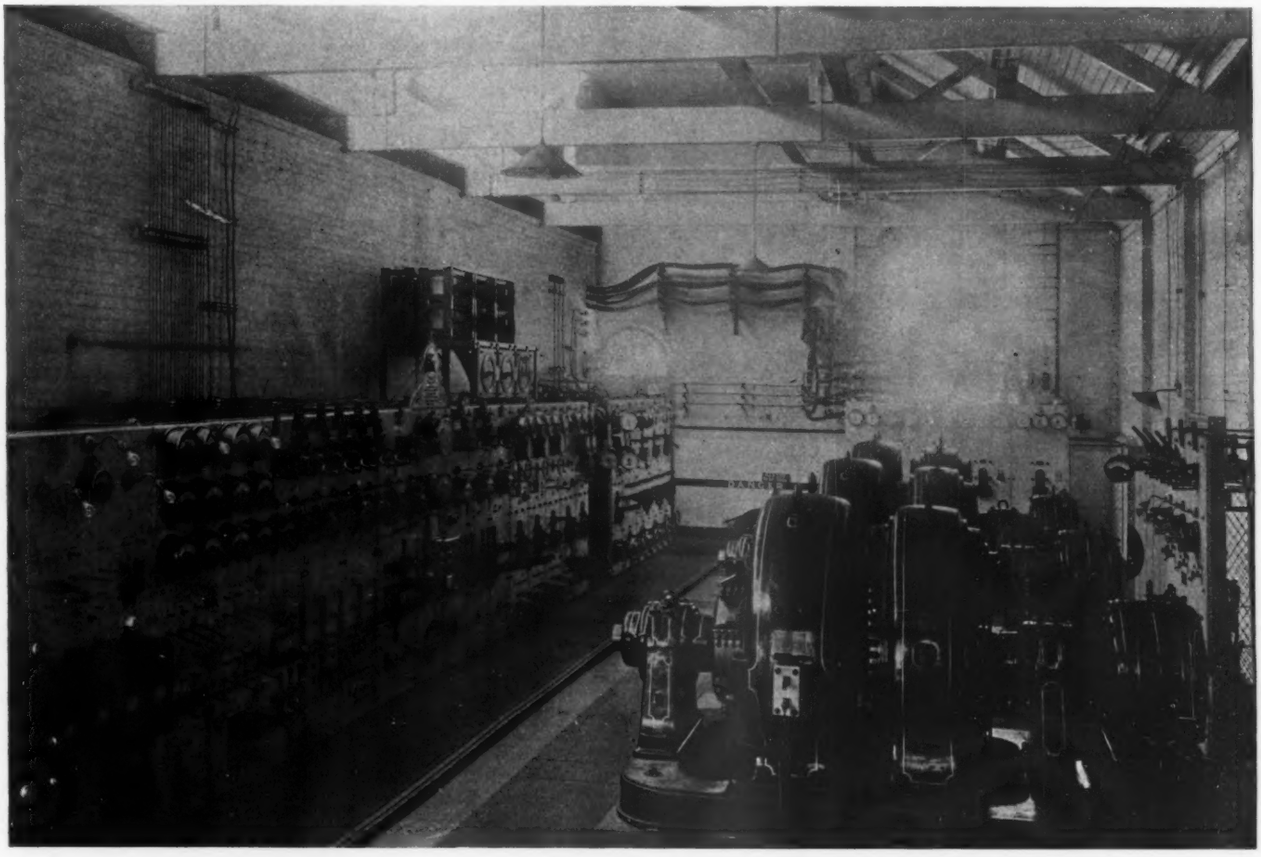


FIG. 1.—VIEW OF INTERIOR OF DUNEDIN SUB-STATION.

ravine to a steel tower located on the top of the first bluff on the opposite side. It was decided that the line should be run in one span in preference to erecting poles at short intervals down the rugged face of the mountain side. This span is 1700 ft. in length, and the horizontal distance between the towers about 1600 ft., the upper tower being 650 ft. above the terminal tower.

The tower at the upper end is constructed of angle steel throughout, and with the insulators so arranged to take the angular strain of the long span cable. This tower was specially built to withstand the strain of the seven cables. The strain of each wire is taken up by four pairs of insulators. Around the neck of each insulator is a "U" bolt, the ends of which pass through a wooden cross-bar. The wire passes through a hole in the center of the cross-bar, and iron clamps are fastened rigidly to the wire and rest against the upper side of the cross-bar. By this means the strain on each pair of insulators can be equalized by means of the nuts on the "U" bolts. Two pairs of insulators are sufficient to take care of the strain of the wire, so that ample margin of safety is provided. Seven wires are suspended across the span, three for each transmission line and one spare cable for use should any of those in service be carried away. This provision was necessary, as owing to the nature of the country at this point it would be a most difficult matter to repair a span. Four of the wires are of steel and

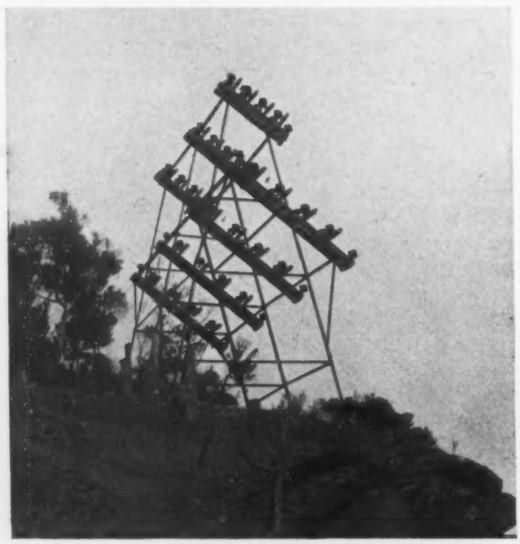


FIG. 2.—HILL-TOP TRANSMISSION LINE TOWER.

three of No. 2 B & S gauge copper, and the latter appear to be as satisfactory as the former, except, of course, that there is not the same factor of safety.

The tower is erected on solid rock, and the cables have a minimum clearance of 10 ft. from the face of the hillside. The spans are not affected by the wind, which blows with great velocity at times through the gorge. They are spaced 10 ft. apart triangularly, and each cable is drawn to the same tension. The lower terminal tower is made entirely of wood, consisting of six hardwood poles. This tower is anchored by guys, so that the only work it does is to hold the cables off the ground; the same methods of attaching the wires to the insulators was adopted as on the hill-top tower.

After leaving the hill-top tower, the transmission wires are carried on Australian hardwood poles, those used on the mountain top being 30 ft. in length with 6 ft. buried in the ground. The question of towers versus wood poles was carefully considered, but as the Taieri Council would not agree to towers being erected along the roads, there was no alternative. The cost is slightly in favor of wooden pole construction.

The insulators are spaced 42 ins. apart, triangularly, the top insulator being attached to the pole. The bottom insulators are carried on ironwood cross-arms gained and fastened to the post by two lag screws. The gains were cut slightly slanting, so as not to provide a pocket for moisture. The cross-arms are 4 ft. 6 ins. long by 4 ins. by 5 ins. The poles are spaced 150 ft. apart, and the two lines of poles are 30 ft. apart over the mountain top.

The transmission wire is of two sizes, No. 2 B. & S. gauge and No. 3 B. & S. gauge, and is of medium, hard-drawn copper with a tensile strength of 50,000 lbs. per sq. in. The reason for two sizes of transmission wire being used was that the Council had purchased, some years previously, 72 miles of No. 2 B. & S. gauge wire for a system then contemplated but never built. This wire was sent out on reels, and was used on the portion of the transmission line on the plains. The No. 3 wire was purchased later and was sent out in bundles for ease of transportation over the hills. There are 164 miles of copper wire in the transmission lines.

After leaving the table-land referred to, the route of the transmission line is along the ridge of the Kowhai Spur or Razorback, and in this case it was also necessary to keep the pole line on the top of the ridge as the sides are covered with dense bush.

In a few places small creeks and depressions were crossed with spans ranging up to 300 ft. in length. Before reaching the

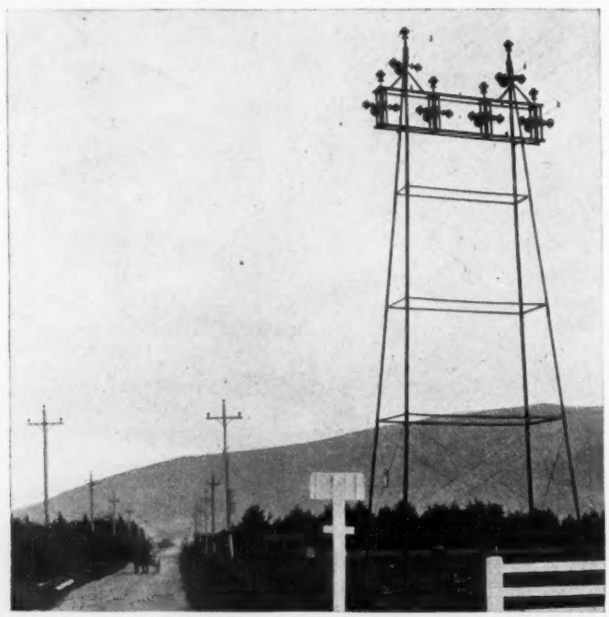


FIG. 3.—TOWER AND POLE LINES ALONG THE HIGHWAYS.

bottom of the Kowhai Spur another long span had to be adopted in order to cross a small valley. This span is 900 ft. in length, and the wires are spread out to 6 ft. spacing, the two lines being supported on long double cross-arms on three poles at the upper end.

The line then continues across private property until it strikes the main road on the plains, seven miles from the power station. From this point the poles are erected along each side of the road, being located in the fence line where the roads are 40 ft. wide, and 6 ft. from the fence alignments where the roads are 66 ft. wide. The line then continues on poles until it reaches the township of Outram, 14½ miles from the power station. At this point towers had to be erected for crossing the railway. These towers were specially designed to prevent any possibility of a wire falling across the railway line, either due to breakage of the insulator or of the wire. The insulators on the towers are only subject to compression strain. Steel wires with a tensile strength of 6000 lbs. are used for the crossing and as the working strain is only 400 lbs. the factor of safety is ample. It is impossible for the cable to fall from the tower if all the insulators break; the copper wires which terminate on the tower above the steel cables are connected to the latter by soldered clamps.

After leaving the Outram railway crossing, the lines run

through private property in order to cut off a long detour and to avoid going through the township of Outram. The line proceeds along the Outram-Mosgiel road and the Northwest Taieri Road until it reaches the site of Sub-station No. 2, 21 miles from the power station, which has already been described. The wires are then carried on steel towers across private property, in order again to avoid a long detour, crossing another line of railway and proceeding thence along the Northwest Taieri Road to the Silver Stream River, 23 miles from the power station.

From this point the route leaves the plains, and is taken four and one-tenth miles through private property, ascending at an average grade of 1 in 8 over a spur of Flagstaff mountain rising to an altitude of 1125 ft., and then descending until it reaches the sub-station at Halfway Bush, 645 ft. above sea level.

At the point where the route of the transmission line is taken through private property at Outram and again after leaving Sub-station No. 2, the lines are carried on steel towers because the property owners objected to a double line of poles running through their lands. These towers are spaced 500 to 600 ft. apart, and each tower carries the six transmission wires and a telephone line. The towers are rectangular structures, the length of the base parallel to the line is one-fifth of the height,

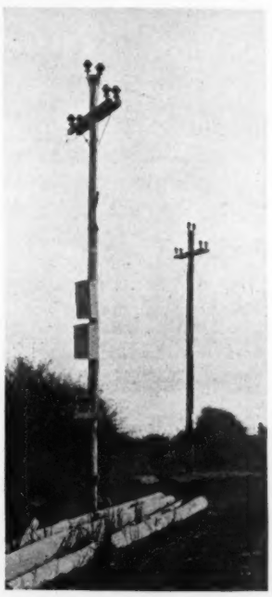


FIG. 4.—POLES AT CROSSING, SHOWING LINEMEN'S TELEPHONE.

and the width is 14 ft. The towers vary from 40 to 50 ft. in height, according to the nature of the ground, and the angle steel sections are in 10-ft. lengths. The bracing stays consist of two No. 7 S. W. G. steel wires, twisted with Spanish windlass and with eccentric washers in the bolts to provide for adjustment of the strain.

Before the design of the tower was decided upon an experimental tower was made, and a strain of 2400 lbs. was put on the extreme end of the tower, this strain being equal to the tortional strain that would result in the event of five of the wires carrying away on one side. In the design of the line a factor of safety of six was allowed. This factor was insisted upon by the Board of Control as being sufficient to provide a safe margin against all snow and wind stresses.

The linemen were provided with adjustable sighting pieces, which were hung at each pole and the cable strained with a sag to correspond with the length of span and temperature of the atmosphere. The wires are tied to the insulator with No. 8 soft-drawn copper, and McIntyre joints are used throughout. No ladders were used in the erection of the line, as the men climbed the poles with spurs, two types of which were used. Neither of the high-tension lines is transposed throughout its length.

One of the Government telephone lines runs parallel to the transmission line for a length of two miles, and at a distance of 1320 ft. from the line, and no trouble is experienced due to induction, only a very slight humming being perceptible.

The insulators and pins were delivered along the route and deposited at the foot of the poles. At first the pins were fixed in with litharge and glycerine cement, as this is quick setting, but as the men complained it made their fingers very sore, and it was found the public did not damage the insulators, Port-

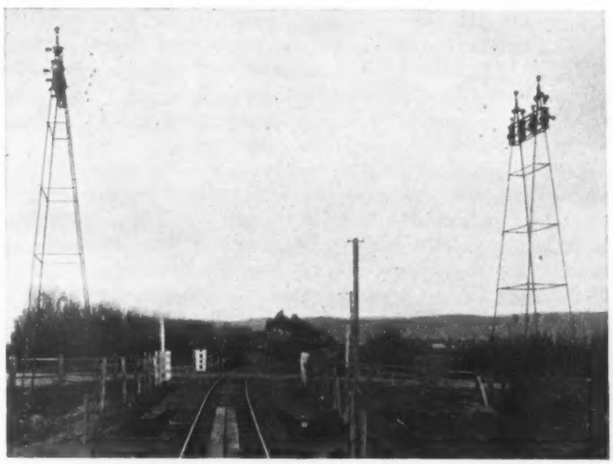


FIG. 5.—TOWERS AT OUTRAM RAILROAD CROSSING.

land cement, mixed one part to one part sand, was used instead and the pins were allowed four days to set. The pins are of ordinary 2-in. galvanized iron pipe swaged in. Iron pins were adopted because it was thought that if wooden pins were used there would probably be trouble due to absorption, owing to the very moist climatic conditions which prevail during a great portion of the year. The pins were made by the Johns-Manville Company, and the insulators by R. W. Thomas & Sons, New York. The insulators are made of brown porcelain throughout.

In the line there are 1802 poles and 15 steel towers. All poles and towers are numbered with enamelled iron plates, and on every alternate pole there is a notice on enameled iron offering

FIG. 6.—BOTTOM TRANSMISSION LINE TERMINAL TOWER AT REAR OF POWER HOUSE.

a reward for information leading to the conviction of any person found damaging the lines or insulators.

At all road crossings there are 45-ft. poles with double cross-arms and insulators, which are also used at all angles. Most of the poles are 35 ft. in length and rough dressed, the wood being either blue gum, flooded gum, tallow wood, blackbutt or turpentine, and cost on an average $11.25 each, erected. All poles are ringed at the top.

There are two linemen whose duty it is to patrol the line daily. They both reside at Outram and are provided with horses, one man proceeding over the 17½ miles of line to the

power station one day, staying there for the night and returning to Outram the next day. The other lineman patrols the 9.6 miles of line from Outram to Halfway Bush, returning to Outram every night. The lineman on this section hands in both linemen's daily reports on every alternate day to the sub-station attendant, who forwards them to the head office.

Each lineman has to call up and report to the power station and sub-station No. 1 at each telephone box along the line, stating the direction in which he is going. These calls are entered up in the log books. The lineman on the power station section has a very rough time during the winter months, as heavy snowstorms prevail, and the ascent and descent is very steep on both slopes of the mountain, so much so that many persons prefer to walk. During the month of June there were several heavy falls of snow, but no snow adhered to the line wires and no line troubles were experienced.

All the insulators were erected by the end of February, and up till May 18 no insulators had been reported broken; in fact, there had been no line troubles of any kind. Since that date three insulators have been broken, but it was not necessary to renew them immediately. It was found necessary to cut down no less than 1400 trees along the route. These trees were mostly blue gums, ranging from 80 to 120 ft. in height. With respect to the ten miles of transmission line through private property, the rights of erection and of patrol were obtained for the moderate sum of $3,000.

The efficiency test of the line confirmed the calculated loss. As previously mentioned, each line consists of 12 miles No. 2 wire, and 15.1 miles No. 3 wire. The calculated resistance is 26.23 ohms, and the measured resistance is 27.11 ohms. Taking 1000 kw at 30,000 volts with 90 per cent power-factor at the receiving station, the line current is 21.1 amperes, the calculated voltage drop, allowing for inductance and impedance, is 2192 volts, and in the test made the measured voltage drop was 2200. Each line is designed to carry the station output with a loss of 8.75 per cent at full load with 85 per cent power-factor.

On one occasion an interesting experiment was made by connecting the transmission lines at sub-station No. 1 and transmitting the energy from Waipori by one line to Halfway Bush and back by the other, and driving the second generator as a motor, the total length of transmission being 54.2 miles.

A telephone line connects the power station to sub-station No. 1, and is carried on bracket insulators on one line of poles. It is a metallic circuit throughout, and the telephone wires are alternately 7 ft. 3 ins. and 7 ft. 9 ins. from the line wires. The wires are transposed vertically and across the pole every three pole lengths, so that a complete helix is obtained in every 12 pole lengths. On the towers, as the spacing of the line wires is different to that on the poles and the interval between the towers is irregular, in order to keep the inductive effect on the telephone line a minimum, instead of the bare copper, as used on the poles, two ordinary insulated telephone service wires were twisted together and strung from tower to tower.

There are nine telephone stations along the line; these are arranged so that the lineman stands on a platform supported on four main-line insulators. The connections in the telephone boxes are made so that the lineman can talk to either end or both ends simultaneously. The telephone instruments are protected with long fuses and a grounding device, so that should the main line wire fall on the telephone, at the time the lineman is using the instrument, it would be grounded and blow the fuse. This system was adopted because it was not deemed advisable for the lineman to carry portable telephones to connect the wires at any point. At the power station and sub-station the telephone instruments are protected in a similar manner. The power station telephone box consists of two independent cabinets, one inside the other and each one lined with felt. This cabinet effectually shuts out sound, and the noise of the water-wheels cannot be heard from inside. The telephone line is only used for service purposes.

HALFWAY BUSH SUB-STATION.

The sub-station at Halfway Bush is connected to the Dunedin station by telephone wires running on the Government poles, as the Board of Control would not allow the main line telephone to be taken into town.

In order to provide a duplicate connection with the power station another telephone line connecting the power station to the Government telephone bureau at Berwick was installed. This line consists of two wires erected on an independent line of poles running parallel to the transmission line and at a minimum distance of 178 ft. from the same over the Maungatua Mountain to the bottom of the Razorback Spur. From this point it is taken along the main roads to Berwick; connection is then made with Dunedin by connecting on to the Government lines, the ordinary bureau charge of 6 cents being made for each conversation. The operators can therefore use this line for private purposes.

Sub-station No. 1 at Halfway Bush, is designed to contain two banks of transformers of three each and one transformer as a spare. Four transformers of the Westinghouse oil-insulated, self-cooling type are installed, three being for service, and one as a spare. Each has a rated capacity of 600 kilowatts, with a ratio of 18,000 to 3300 volts. Taps are brought out on the high-tension side at 17,000 and 16,000-volt turns. The efficiency is 98 per cent at full load, with unity power-factor and 97½ per cent at 90 per cent power-factor. The regulation is 1.1 per cent and 2.9 per cent at 90 per cent power-factor at unity power-factor.

The transformers are connected in "star" on the high-tension side and in "delta" on the low-tension side. As it was found necessary to take distributing mains from this sub-station, in order to provide easy regulation of the single-phase circuits, these mains are connected in "star," and an artificial neutral is provided by means of a No. 2 B. & S. gauge bare copper wire carried on the top of the low-tension transmission lines poles from the sub-station and connected to the neutral point of the synchronous motors in the Dunedin station. Each transformer is connected to an oil system, so that the oil can be drawn off into a well from where it is elevated by means of a hand-pump to overhead tanks. Each transformer is on wheels, so that it can be wheeled underneath the crane for repairs.

The system of wiring in the sub-station is similar to that adopted at the power station. The high-tension transmission lines enter through openings of the southern end of the building, and are connected to oil insulated choke coils and low-equivalent Westinghouse lightning arresters, similar to those at the power station. Each line is then taken to an automatic oil

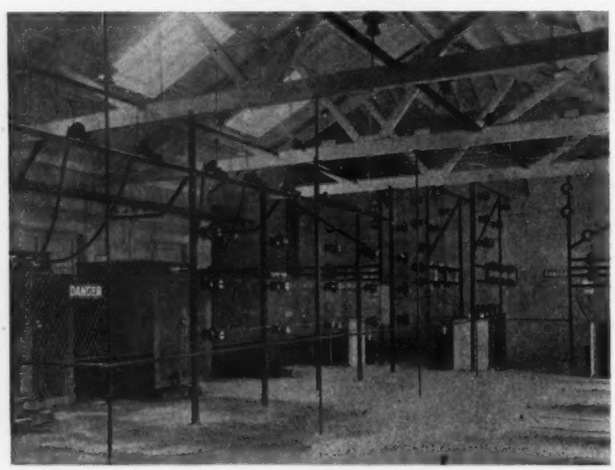


FIG. 7.—VIEW OF INTERIOR OF SUB-STATION AT HALFWAY BUSH.

switch connecting to the high-tension bus-bars, and an oil switch is located between line oil switches for paralleling the high-tension bus-bars.

The series and shunt transformers for overload relays and voltmeter are located on the line side of the oil switches and protected by long fuses enclosed in porcelain tubes. A three-phase transformer is connected to the low-tension bus-bars for the lighting circuits in the power station and residence. The

transformers are connected on the high-tension side, with flexible cables and plug switches to the bus-bars, so arranged that the spare transformers may be cut into any phase of either bank. The low-tension leads are connected by clamps to the 3300-volt bus-bars, which are overhead and run to the low-tension switchboard located at the northern end of the building. This switchboard is 20 ft. long; there are three panels controlling the transmission lines to Dunedin. On each panel there is an automatic oil switch with time-limit relay, and one double-throw, oil-switch, by means of which the outgoing line may be

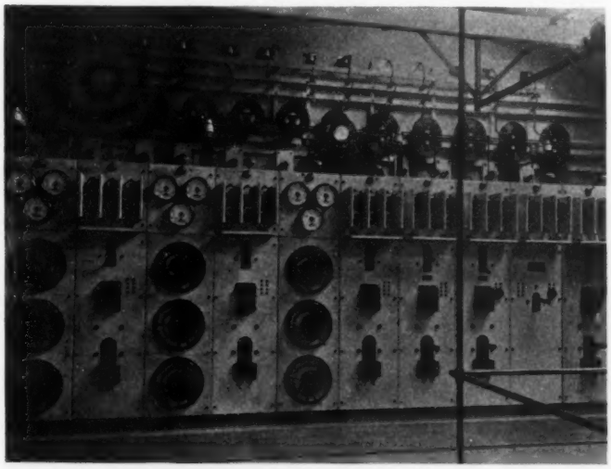


FIG. 8.—3000-VOLT SWITCHBOARD IN HALFWAY BUSH SUB-STATION.

connected to either bank of transformers. There is a voltmeter receptacle and six knife disconnecting switches, for the purpose of isolating the oil switches; three of these are on the front of each panel, and three on the back. There is also a one-line paralleling panel, on which there are six disconnecting switches and one hand-operated, oil-switch, for paralleling the low-tension bus-bars. Provision has also been made for three local circuits to be taken from the sub-station; each circuit is controlled by two panels, on which are mounted six disconnecting switches, one automatic oil switch with time-limit relay, one double-throw oil switch, one voltmeter receptacle, three ammeters, one on each leg, and three potential regulators, by means of which the line potential can be varied 10 per cent either way.

At the back of the switchboard there are choke coils and Westinghouse lightning arresters on each line. The building is 68 ft. by 36 ft. by 16 ft. high, constructed of wood and galvanized iron, with concrete floor and lined inside with fibrous plaster on expanded metal.

An air duct runs under each bank of transformers by means of which air is forced from a blower, and can be impinged on the transformer cases to facilitate cooling.

Adjacent to the sub-station is an attendant's cottage for the electrician-in-charge.

The low-tension transmission line leaves the sub-station at the northern end, and conveys the energy to the sub-station in Dunedin. The line is in duplicate and carried overhead for 1½ miles and then underground for ½ mile through the business section.

The overhead cables are 0.2 sq. ins. in section and have triple-braided, weatherproof insulation. The six cables are carried on one cross-arm, and are spaced 12 ins. apart, and both lines are transposed twice. The poles are dressed hardwood, 35 ft. long, with 6 ft. in the ground and located along the curb line.

At the point where the line is taken underground a large chamber under the sidewalk contains choke coils and lightning arresters for the protection of the two underground cables, which are 3-core, paper-insulated, and drawn into conduits laid under the sidewalks. Each line is designed to carry 1000 kilowatts. A second cross-arm has been provided on each pole for extra lines when required.

DUNEDIN SUB-STATION.

The Dunedin sub-station is practically in the center of gravity of the railway system, and also of the commercial system. From the station alternating-circuit is distributed in and around the city for commercial lamps and motor circuits, and direct-current for the railway and street arc lighting system. The building is of brick, and is 65 ft. wide by 99 ft. long.

The generator room is 28 ft. 6 ins. wide by 77 ft. long, and contains the machinery and switchboards. Adjoining this room is the transformer fireproof chamber, 10 ft. wide by 52 ft. long; to the right of the transformer room there are two battery rooms, one above the other, and each 23 ft. wide by 77 ft. long.

In the generator room there are three motor-generators, each unit consisting of one Westinghouse 440-hp, 3000-volt, three-phase synchronous motor, coupled to a 300-kw, 550-volt, direct-current generator. The field structure of the motor, and the armature of the generator are mounted on one shaft, which is extended at the motor end to carry the rotor of a 40-hp, 400-volt induction, starting-motor. The connections are arranged on the switchboard so that the set may be started and synchronized from either the direct-current or alternating-current side.

It was first intended to install rotary-converters as the translating device from alternating-current to direct-current, but owing to the contemplated nature of the motor load on the system it was decided to install motor-generators in order to get the advantage of leading wattless current by means of the synchronous motors when required.

The switchboard is located on three sides of the generator room, and its total length is 68 ft. The board adjoining the transformer room is divided into three sections. The first section comprises five panels; one for controlling the incoming transmission line, one for controlling the exciter and motor, and three panels for controlling the synchronous motors. The second section, consisting of five panels, controls the low-tension distribution circuits and the other incoming transmission line. The third section consists of four panels for controlling the 3000-volt circuits.

At the end of the first section are the panels for controlling the railway circuits and two arc-lamp panels; there being 60

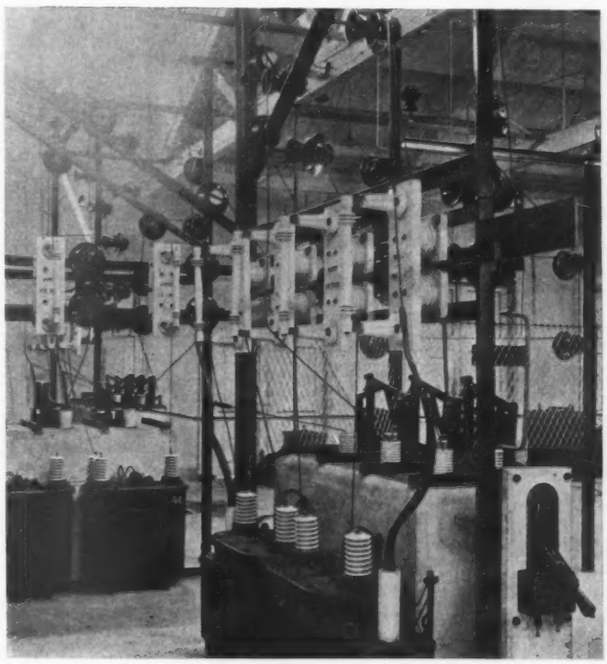


FIG. 9.—INTERIOR OF HALFWAY BUSH SUB-STATION.

enclosed arc lamps erected on top of the railway poles. On the opposite side of the room is a switchboard for controlling three steam-driven generators located in a station adjoining the sub-station. This plant, consisting of three 200-kw generators coupled to Bellis engines, will be kept for stand-by service. This equipment has been used during the past three and one-half years for operating the railways.

At one end of the generator room is an exciter set for the

synchronous motor. This is made up of a 400-volt induction motor and a 20-kw, 125-volt generator. A special motor-generator set has been installed, consisting of a 500-volt, direct-current motor coupled to a 60-kw, three-phase, 400-volt, 50-cycle generator. This unit is intended to supply electrical energy to the railway department in the event of the failure of the transmission lines, the energy for operating the motor being obtained from the steam-driven plant. There is also a differential battery booster consisting of a 37½-kw generator coupled to a 50-hp, direct-current motor.

In the transformer room at the rear of the switchboard are four 150-kw, oil-insulated, water-cooled transformers (one being a spare), ratio of 3000 to 242 volts, connected in "delta" on primary and in "star" with neutral grounded on secondary. The high-tension side is wound to give 10 per cent regulation up or down, and has turns tapped for 3300 and 2700 volts.

The high-tension bus-bars are run overhead, and connect to the oil switches on the switchboard. The transformers are connected to water and oil service systems; and in the transformer room there are also 39 regulating and instrument transformers. In the lower battery room there is a 300-ampere battery with 200 cells. The whole of the sub-station equipment was supplied by the Westinghouse Electric & Manufacturing Company.

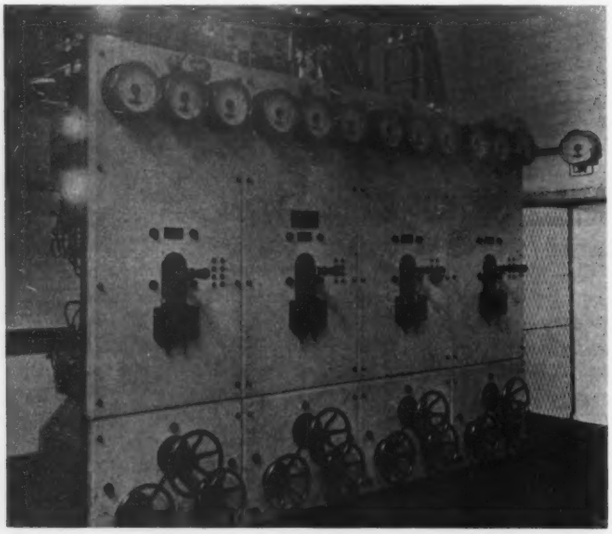


FIG. 10.—3000-VOLT DISTRIBUTION BOARD IN DUNEDIN SUB-STATION.

The low-tension distributing net-work in the business section of the city is by means of underground Callender's vulcanized bitumen cables, laid on the solid system in a new form of cement conduit. The feeders to the net-works are four-core cables. The four cores are of equal sectional area, so that in the event of any core feeding the outers becoming grounded, it could be exchanged with the core serving as neutral.

The mains are laid along each side of the streets under the sidewalks and consist of four separate cables, the neutral having half the sectional area of the outers. These mains are also laid on the solid system, and service boxes are provided at every alternate building. The out-lying portions of the city and suburbs contiguous to Dunedin have been supplied with overhead mains at 3000 volts, with local transforming stations at points of distribution.

RATES FOR ENERGY.

After a careful consideration of the capital charges per unit sold per annum and the cost of generating and distributing the energy, the following rates were fixed:

Energy for lamps lighted during ordinary hours, 10 cents per kw-hour for the first 1½ hours, and afterward 2 cents per kw-hour.

Energy for special lighting during extraordinary hours, 8 cents per kw-hour for the first hour, and 2 cents per kw-hour thereafter.

Energy for motors, 4 cents per kw-hour for 50 kw-hours consumed per month per kilowatt or brake horse-power installed, and 1 cent per kw-hour thereafter.

For special consumers whose average demand is over 25 kilowatts, special rates are quoted to suit the nature of the demand.

The railway is charged for energy at the rate of 1½ cents per kw-hour since all the moving machinery, the battery and half the switchboard is used solely for railway purposes and necessitate three extra attendants.

In Dunedin the summer days are long and the twilight lasts till 9 p. m. Nearly all the shops close on ordinary week nights at 6 p. m. and at 9 p. m. on Saturdays: the large retail houses close at 1 p. m. on Saturdays. For these reasons, and bearing in mind the probable nature of the load factor, and the anticipated diversity factor, no flat lighting rates are in use, and a high rate on the maximum demand system for one and one-half hours per diem was used instead. This system of charging, considering the latitude of the locality, is undoubtedly the fairest to the long-hour consumer, as the larger shops and retail houses would only require lighting during about four months of the year from 4 p. m. to 6 p. m., Saturdays and Sundays excluded, and as the capacity of the generating plant, mains, etc., has to be sufficient to supply consumers of this class for such short periods of the year, it follows that there should be a wide range between the high and low rates of the "maximum demand system." The large shopkeepers, therefore, will pay 10 cents per unit, but the small householder, who will probably keep all his lamps running for an average of three hours per night throughout the year, will pay 6 cents per unit. The reason the charge for energy for motors was fixed on the consumption per kilowatt installed was to avoid the use of maximum demand indicators on the motor circuits.

The whole of the work in connection with the dam, flume and pipe-line was designed and carried out by Mr. F. J. Williams, the corporation's hydraulic engineer. The electrical installation was designed and carried out by Mr. W. G. T. Goodman.

Electrical Equipment of the Fort Dodge, Des Moines & Southern Railway.

The cities of Fort Dodge, Boone and Des Moines, Ia., separated by a total distance of only about 90 miles, were for the first time on Nov. 4 placed in direct railway communication by the opening for traffic of the Fort Dodge, Des Moines & Southern Railway. This system combines the electrical equipping of a steam road with new interurban construction. Fort Dodge, like Des Moines, is a very active business town and is also a railroad center of importance. The town of Boone, located midway between, is also an active center. Each of these three cities is situated on one or more important trunk line railroads, which in no case connect directly with the other cities. The railroads in question are the Illinois Central and Chicago Great Western at Fort Dodge, the Rock Island and Chicago, Milwaukee & St. Paul at Des Moines, and the Chicago & Northwestern at Boone, all of which, with one exception, lie practically parallel. The new system links the towns, and therefore connects the railroads at these points, and it will readily be seen that its operation bears vitally on the local traffic problems of the trunk lines concerned, although it is essentially an independent interurban property. The operation of this railway will undoubtedly afford data useful to steam roads in the general problem of the electrical equipping of branch lines.

When the project was undertaken there was a small steam railroad property, the Newton & Northwestern Railroad, running about northwest from Newton through Boone to Rockwell City, or almost in the direct line between Fort Dodge and Des Moines, though without reaching either city. Briefly then the

present project has consisted in the electric equipping of 42 miles of this steam road and the construction of 25 miles of new line from each end of the electrical section to Fort Dodge and to Des Moines, respectively. A branch line 5 miles long has also been built from Kelley on the main line to Ames, where the Iowa State College is located.

The plans originally contemplated and now in force involve the operation of through electric cars between Des Moines and Fort Dodge, but certain portions of the original Newton & Northwestern, which now become spurs to the through route, are still operated by steam.

The electric passenger train service is based on an average speed of 27½ miles per hour, including 15 regular stops, which means that a maximum speed of nearly 60 miles per hour is frequently attained between stations by the heavy electric express and passenger cars. The total running time from terminal to terminal is 3 hours 50 minutes, but 43 minutes are consumed in covering 4 miles within city limits at Des Moines and 2½ miles in Fort Dodge.

To provide for the high maximum speed on the system it was necessary to rebuild the permanent way of the electrically equipped section of the Newton & Northwestern Railroad. The road was reballasted with gravel and equipped with heavy rails throughout, and the extensions were constructed to the same standard. Fairly level country is traversed, permitting small gradients except near Boone, where the line crosses the Des Moines River, and the country is rugged and cleft by deep ravines. On this section a 2½ per cent grade is encountered, while still heavier grades were obviated on the original line in the Des Moines River Valley only by a series of trestles, bridging the ravines before mentioned, where they emerge into the river flats. One of these trestles just west of Boone is among the highest and longest in the country.

Each car is provided with four 75-hp direct-current motors, which give a maximum speed on the level of nearly 60 miles an hour. All cars are single ended and have locomotive pilots. They are equipped with standard radial draw bars and M. C. B. railway couplers to permit coupling to the steam railroad cars. Multiple unit control apparatus is installed on all electric cars for operating in trains.

The passenger car bodies are 43 ft. long over corner posts. At the front end there is a baggage compartment 10 ft. long containing movable seats, and back of that a smoking compartment 12 ft. 6 ins. long containing seats. The heating is by hot-water apparatus. With the seats filled these cars weigh about 38 tons.

The energy for electric operation is derived from a 3000-hp turbine-driven plant, located at Frazer, on the Des Moines River, about equidistant from the terminals. Coal mines nearby supply cheap fuel in the form of Iowa bituminous slack coal, while the feed water comes from the river, passing through purifiers to reduce the scale-forming salts. The main generating equipment consists of two 1250-kw Parsons type turbo-generators supplied with steam at 175 lbs. pressure from two batteries of water-tube boilers, the flues of which connect with an 180-ft. chimney.

The energy is generated, alternating, three-phase, 25 cycles at 2300 volts. The e. m. f. is stepped up to 20,000 volts for transmission to five sub-stations located at Ankeny, Kelley, Boone, Fort Dodge Junction and Otho, at an average distance apart of about 15 miles. The sub-station in the power house consists of three 145-kw water-cooled, oil-insulated, 2300 to 370-volt single-phase transformers and one 400-kw, 600-volt rotary converter. The other sub-stations are uniform, each containing three 145-kw, single-phase, 20,000 to 370-volt, oil-cooled transformers and one 400-kw, 600-volt rotary converter, with room for the installation of a second converter if desired. The converters are of standard Westinghouse design.

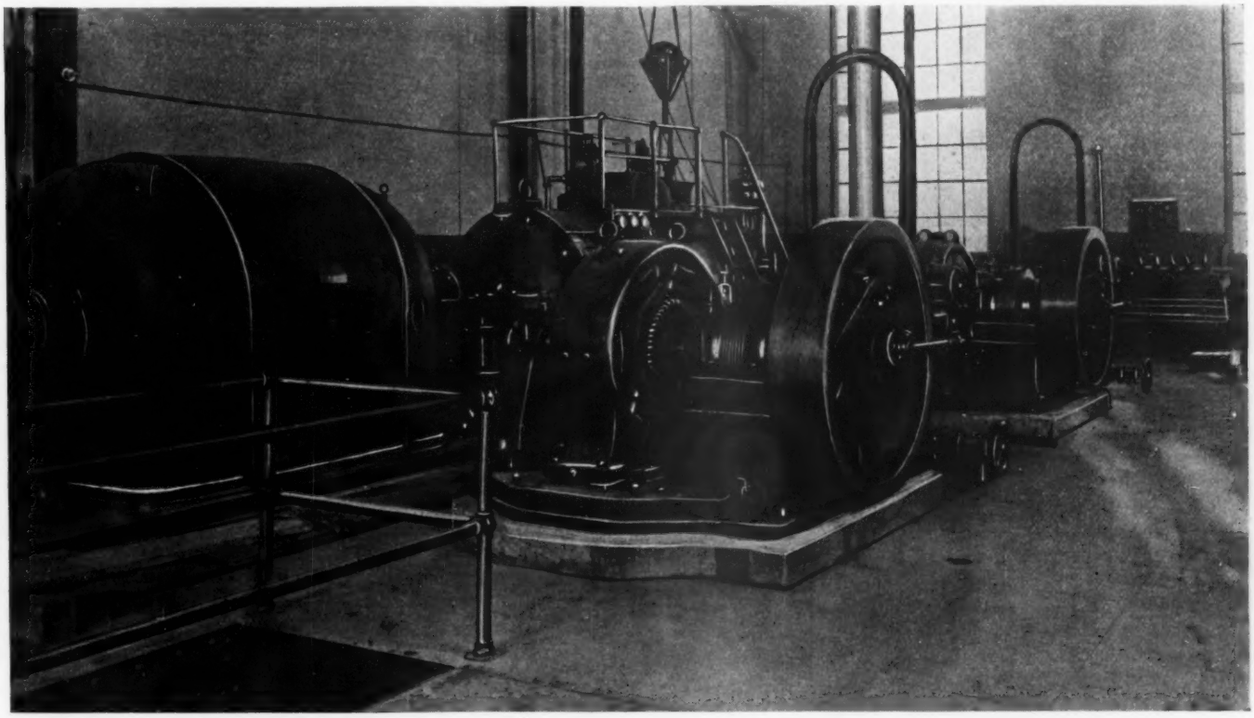


FIG. 1.—INTERIOR VIEW OF THE FRAZER GENERATING STATION.

The transmission line is designed for a maximum e. m. f. of 33,000 volts, the wires being No. 4 B. & S., spaced 48 ins., and carried on porcelain insulators 7½ ins. high and 8½ ins. in diameter. The insulators are tested to 75,000 volts. Poles of not less than 8 ins. top diameter are used and are spaced 100 ft. apart on tangents, being set in concrete points where advisable.

The overhead work is the standard bracket construction except at turnouts, where span construction is used. Frogs are not used on the trolley wires at turnouts, the wire for the siding being run parallel to the main wire with a space of 18 ins. for a distance of 100 ft. beyond the end of turnout in either direction. The track is bonded with 300,000 cir. mil soldered bonds and cross bonded at intervals of 500 ft. with No. 4-0 B. & S. copper wire.

The engineering, construction and equipment of the sys-

tem, including generating station, transmission lines, sub-stations, overhead work and bonding, telephone dispatching facilities, rolling stock and car barns, have been in charge of J. G. White & Company. The Northwestern Construction Company

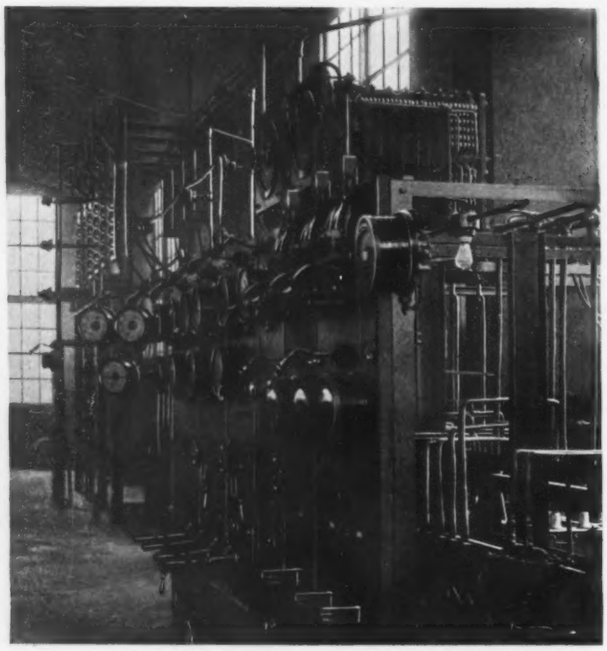


FIG. 2.—SWITCHBOARD IN FRAZER STATION.

carried out the construction and reconstruction of the permanent way. The entire work was carried out under the supervision of J. L. Blake, general manager of the Fort Dodge, Des

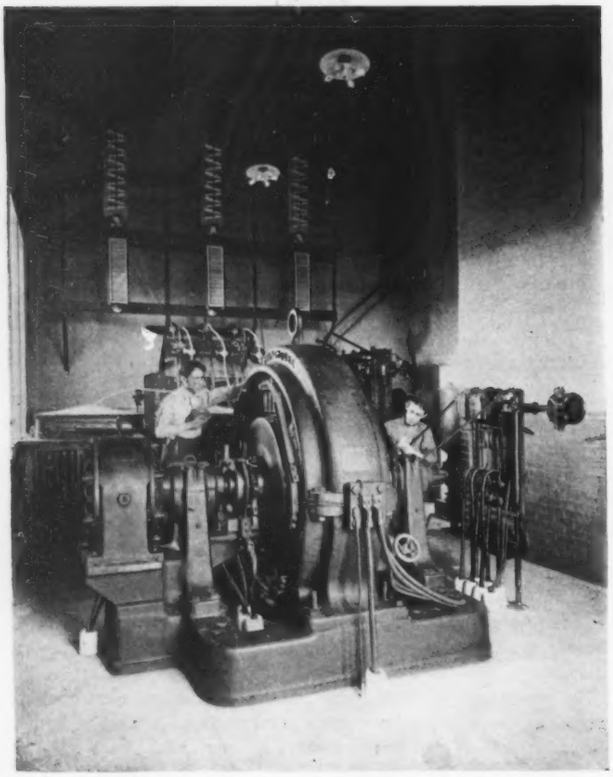


FIG. 3.—CONVERTER EQUIPMENT IN ANKENY SUB-STATION.

Moines & Southern Railway, representing the owners. The main turbo-generators with the other principal electrical apparatus, including the car equipment, is of Westinghouse manufacture. The cars were made by the Niles Car & Manufacturing Company, and the trucks by the Baldwin Electric Works. They are heated by the Peter Smith hot-water apparatus. In the power house the boilers are of the Babcock & Wilcox Company, Aultman-Taylor type. Wheeler Condenser & Engineering Company's surface condensers and Cochrane feed-water heaters are used. The chimney was built of concrete and steel by the American Chimney Company under the specifications of J. G. White & Company.

Representation of Armature Reaction of the Synchronous Motor as an Equivalent Reactance.

BY A. S. LANGSDORF.

In an article on "Excitation Characteristics of the Synchronous Motor," published in the issue of the ELECTRICAL WORLD for Oct. 19, the author derived a series of equations representing the behavior of the motor under various conditions of operation. The results as there recorded are expressed somewhat differently from those usually found in the literature of the subject in that the effects due, respectively, to armature impedance and armature reaction are separated from beginning to end, instead of being combined at the outset into one term as "synchronous impedance." After the completion of this paper, but before its publication, the appearance of the excellent article on "Circular Current Loci of the Synchronous Motor," by Dr. A. S. McAllister (ELECTRICAL WORLD, Aug. 24), indicated that the writer's former results might be reduced to corresponding graphical form, and this has been done in what follows. While the results are the same in the two cases, the methods are quite different; and, in addition, the results here given afford a basis of comparison between the usual expression for synchronous impedance and its value in terms of its components, armature reaction and pure armature impedance; and also a proof that the "synchronous reactance" is constant under the conditions assumed.

The assumptions made in deriving the original equations are here repeated for the sake of completeness. They were: Unsaturated magnetic circuit (induced e. m. f. proportional to excitation); constant magnetic reluctance and constant armature magnetic reactance, or that the actual variable values of these quantities might be replaced by their averages; and finally, the possibility of combining vectorially the m. m. f.s of the armature and the main field currents, in determining the resultant m. m. f. These assumptions are equivalent, in part, to assuming that the magnetic reluctance around the air-gap is constant, which is, of course, not the case in reality.

Fig. 1 represents the time-phase relations of the various quantities involved in the operation of the motor. E_0 is the impressed e. m. f., E_1 the counter-generated motor e. m. f., e the "resultant" e. m. f. in the motor circuit, i the armature current, and F_a, F, and F_r the m. m. f.s corresponding to the armature, main field and resultant field, respectively. The necessary condition is that F_r and E_1 shall be in time-quadrature. In the equations below, r and x are the resistance and average local magnetic reactance of the armature, respectively; k is a constant, such that $F_a = ki$; and m is a constant, such that $F_r = mE_1$. It was shown in the writer's former paper that the following equations hold:

$$i^2 = \frac{m^2E_0^2 - 2mE_0F\sin\alpha + F^2}{a^2 + b^2} \qquad (1)$$

$$P = \frac{aE_0F\cos\alpha + bE_0F\sin\alpha - F^2r}{a^2 + b^2} \qquad (2)$$

where P is the total power developed by the motor, and where

$$a = k + mx$$
$$b = mr.$$

The meaning of the angle α is clearly shown in Fig. 1.

It was also shown that the current i consists of horizontal

and vertical components (that is, quadrature and in-phase components, as per Fig. 1), which are, respectively,

$$i_h = \frac{a(mE_0 - F\sin\alpha) - bF\cos\alpha}{a^2+b^2} \tag{3}$$

$$i_v = \frac{aF\cos\alpha + b(mE_0 - F\sin\alpha)}{a^2+b^2} \tag{4}$$

Inspection of equation (1) shows that the minimum value of i, for a given value of F, occurs when $\alpha = \frac{\pi}{2}$; and that the

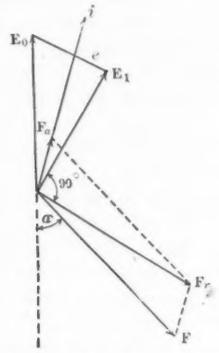


FIG. 1.—VECTOR DIAGRAM OF SYNCHRONOUS MOTOR.

maximum value of i occurs when $\alpha = -\frac{\pi}{2}$. The actual values of i corresponding to these two special cases are,

$$i_{min.} = \frac{mE_0 - F}{\sqrt{a^2+b^2}} \tag{5}$$

$$i_{max.} = \frac{mE_0 + F}{\sqrt{a^2+b^2}} \tag{6}$$

The phase positions of these two currents are determined by obtaining the ratio $\frac{i_v}{i_h}$ from equations (3) and (4), which ratio gives the slopes of the current vectors from the horizontal. In both cases the ratio is $\frac{b}{a} = \text{cotan}\,\Phi$, Φ having been defined by the relation $\tan\Phi = \frac{a}{b}$. That is, both of these special currents lie along a line OC (Fig. 2), which makes an angle Φ with E_0. If in Fig. 2 the following values are chosen,

$$OC = \frac{mE_0}{\sqrt{a^2+b^2}}$$

$$CH = \frac{F}{\sqrt{a^2+b^2}}$$

and a circle is drawn with center C and radius CH, the circle is the locus of the current i, so long as the excitation retains the value which fixes CH. For if the line FCE is drawn perpendicular to OC, and CI is drawn so that angle FCI is equal

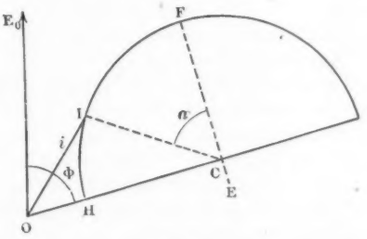


FIG. 2.—CIRCULAR CURRENT LOCUS OF SYNCHRONOUS MOTOR.

to α, the side OI of the triangle OCI is determined by the well-known trigonometrical equation

$$\overline{OI}^2 = \overline{OC}^2 + \overline{CI}^2 - 2\overline{OC}\cdot\overline{CI}\cos(90-\alpha)$$

$$= \frac{m^2E_0^2}{a^2+b^2} + \frac{F^2}{a^2+b^2} - \frac{2mE_0F\sin\alpha}{a^2+b^2} = i^2$$

which is identical with equation (1).

Comparing Fig. 2 with the corresponding diagram of Dr. McAllister's paper, it will be noted that here the angle E_0OC is $\Phi = \text{arc tan}\,\frac{a}{b} = \text{arc tan}\,\frac{k+mx}{mr}$, while in the latter the same angle is $\Theta_z = \text{arc tan}\,\frac{x_m}{r}$. That is, $x_m = \frac{k}{m} + x$, or, in other words, the "synchronous reactance" is a constant, under the conditions assumed. Further, in the analysis above,

$$OC = \frac{mE_0}{\sqrt{a^2+b^2}} = \frac{E_0}{\sqrt{\left(\frac{k}{m}+x\right)^2 + r^2}}$$

Which agrees with the value $\frac{E}{\sqrt{r^2+x_m^2}}$ given by Dr. McAllister. Similar remarks apply to the value of CH. It may be stated, therefore, that to the extent that the armature m. m. f. may be combined vectorially with the field circuit m. m. f. and the air-gap reluctance may be considered uniform, "armature reaction" is equivalent in its effect to a virtual increase in the local magnetic reactance of the armature.

The total power developed by the motor, as given by equation (2), includes the losses due to friction and windage, hysteresis and eddy currents. It excludes the armature ohmic loss. Consequently,

$$E_0 i\cos\Theta = P + i^2r \tag{7}$$

where Θ is the angular phase difference between E_0 and i, (See Fig. 3) and P is the power developed by the motor, in watts.

Equation (7) may be written

$$i^2 - \frac{E_0}{r}i\cos\Theta = -\frac{P}{r} \tag{8}$$

adding $\left(\frac{E_0}{2r}\right)^2$ to both sides of (8), there results

$$\left(\frac{E_0}{2r}\right)^2 + i^2 - 2\left(\frac{E_0}{2r}\right)i\cos\Theta = \left(\frac{E_0}{2r}\right)^2 - \frac{P}{r} \tag{9}$$

Imposing the condition that the power developed by the motor shall be constant, the right-hand side of (9) becomes constant; or if

$$\left(\frac{E_0}{2r}\right)^2 - \frac{P}{r} = U^2$$

it follows from (9) that

$$\left(\frac{E_0}{2r}\right)^2 + i^2 - 2\left(\frac{E_0}{2r}\right)i\cos\Theta = U^2 \tag{10}$$

The geometrical meaning of equation (10) is seen in Fig. 3. It is that the locus of i, for constant power, is a circle of radius

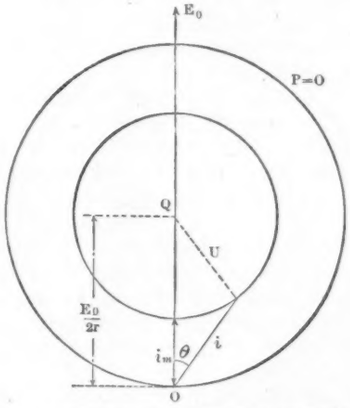


FIG. 3.—CURRENT LOCUS, CONSTANT POWER.

U, whose center is at a point Q, such that OQ equals $\frac{E_0}{2r}$. Since under the above conditions, the armature current is a minimum when $\Theta = 0$,

$$U = \frac{E_0}{2r} - i_m$$

i_m being the minimum current consistent with the chosen value

of *P*. Fig. 3 is identical in all respects with the corresponding figure in Dr. McAllister's paper.

By superposing Figs. 2 and 3, the usual "V-curves" may be

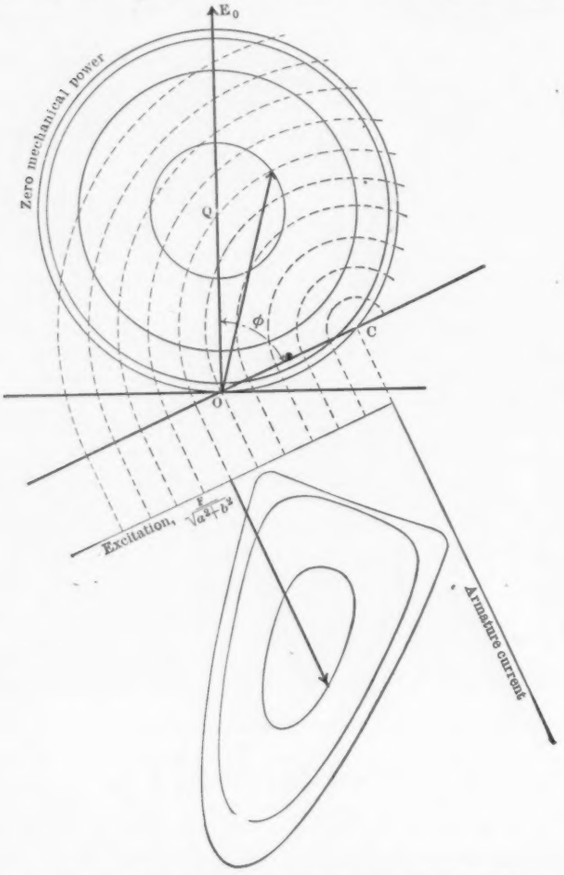


FIG. 4.—COMBINED CIRCLE DIAGRAMS AND V-CURVES.

readily constructed, as indicated in Fig. 4. Inasmuch as this step is clearly explained in Dr. McAllister's article, explanations are here unnecessary.

The Problem of Color Photometry.

By J. S. Dow.

THE letter by Dr. Lummer in the ELECTRICAL WORLD of Sept. 21, and the editorial comments on the subject of color photometry occasioned thereby, are of special interest at the present moment.

Until recently our sources of light resembled each other very closely in color, because our light was invariably derived from incandescent solid particles, which, however, resembled the theoretical "black body" more or less closely. Under these circumstances, the natural period of the atomic systems of which the incandescent body was composed were not given free play; we therefore obtained a confused jumble of vibrations and a continuous spectrum. The radiation so produced, as we now know, is not even confined to the visible spectrum. In most cases the vast majority of the energy is generated in an invisible form and the efficiency of light production is correspondingly low.

But lately, the utilization of "selectively radiating" substances—that is, which exhibit a preference for radiation of a particular wave length not in accordance with the black body law—has entirely altered the aspect of color problems. By the use of this principle we may hope to be able to control ultimately the spectrum of our illuminants much more completely than at present; we may, even, succeed in limiting the output of a source of light to radiation of a single frequency, and, therefore, the value of light to certain colors, for particular purposes, is of greater interest than in the past.

Already the flame arc, and especially the mercury-vapor lamp, yield spectra differing considerably from the older illuminants, and the introduction of the German quartz-tube mercury lamp, which enables us to obtain ultra-violet energy in far greater profusion than hitherto, has already brought to light many unsuspected uses to which energy of this description may be put.

It is evident, therefore, that the problem of comparing the illuminating powers and other qualities of differently colored lights requires early consideration, and the object in writing this article is to point out some of the photometrical difficulties with which illuminating engineers will have to contend.

In the first place, it must certainly be definitely recognized that, quite apart from the technical difficulties of color-photometry, no rigorous photometrical system, not even measurements upon the spot with illuminometers, can yield all the information about a source of light that the illuminating engineer will frequently desire to know.

A source of light may be called upon to achieve many different objects, some of them not really connected with the power of creating brightness, i. e., the "illuminating power" of the source. One extreme instance is the chemical and photographic properties of a source of light, but there are many others less remotely connected with the brightness, and yet depending upon certain frequencies of vibration, which may be of but little use from the point of view of illumination.

It does not follow that a source of light which is intended to illuminate a dwelling room is also a good one to read by, or for the revelation of fine detail. In the first case we chiefly desire to exhibit the æsthetic qualities of the room, and our source of light must therefore be such as to give to delicate shades of color their true values. In the second case we are chiefly anxious that the fine detail we are illuminating shall appear as "sharp" and clear as possible, and this is not a matter of brightness only.

Yet other cases occur in which the *brightness* is the essential quality, quite apart from the true delineation of color. In such cases our object should clearly be to produce the efficient yellow light in the spectrum only, and not to waste energy in producing the deep red and violet components which, for a given expenditure of energy, add but little to the total luminosity of the source. Lastly, reference may be made to the vexed question of the value of light of different colors for the purpose of penetrating mist and fog, which is admittedly not a matter of brightness alone, though the exact influence of the wave length of the light utilized is a matter of some doubt.

These are only a few of the many existing cases, each of which demands special qualities from the light employed, and therefore special methods of measurement. Photometry, as usually understood, concerns itself with the measurement of the power of creating brightness, on the part of the light tested—certainly its most useful but not its only function. In order to measure the value of light for other purposes we can only devise additional tests, not, however, made upon a strictly photometrical basis.

Let us now turn to the consideration of some of the difficulties which beset photometry proper.

In accordance with what has been said already, it will be admitted that a photometrical method of testing any illuminant, ought, strictly speaking, to be carried out in such a manner as to compare the brightness of two illuminated surfaces. This is accomplished in photometers of the ordinary "equality of brightness" pattern, such as the Lummer-Brodhun, the Joly, and the grease-spot protometer.

Unfortunately, in the case of differently colored sources of light, the average observer finds it very difficult to decide when the two photometrical surfaces appear equally bright. The author, however, is inclined to think that there is no insuperable difficulty in making such a judgment, that proficiency is chiefly a matter of practice, and that the personal differences of different observers who are not actually color-blind, are not so great as is commonly supposed. Probably many supposed "personal" errors may be traced to the fact that the two

observers did not utilize the same portion of the retina during their observations, or otherwise failed to secure exactly the same physiological conditions.

To facilitate such judgments, however, many special systems of photometry have been proposed. With these methods we shall presently briefly deal, and we shall see that they are all open to possible objection from one point of view or another.

For the moment, however, let us admit the possibility of a practiced observer being able to make a fairly accurate judgment of the equality of brightness of two differently colored surfaces, and consider what this judgment really means.

Such a judgment must invariably be affected by the effect mentioned by Lauriol, and by Dr. Lummer in his recent letter (ELECTRICAL WORLD, Sept. 21, 1907), namely, the influence of the portion of the retina on which the image of the illuminated surfaces is received.

It has long been known by physiologists that the central portion of the retina, the "macula lutea" or "yellow spot" as it is termed, is less sensitive to the green end of the spectrum than the surrounding portion. Suppose, therefore, that the image of the surfaces in a photometer illuminated by two sources which differ in color, is received upon the retina, and we adjust the position of the photometer until the two surfaces appear equally bright. Now, if we walk away from the photometer so that the image of the illuminated surfaces falls more towards the center of the retina, this equality of brightness is found to exist no longer. The redder of the two lights now appears the brighter. And if we keep the distance of the eye from the photometer the same, but select a photometer in which the photometrical surfaces are different in size from those previously used, we may again come to a different conclusion, for the portion of the retina occupied by the image of the illuminated surfaces is again changed.

When dealing with more or less pure colors the effect may be very marked indeed. In a recent paper before The Physical Society of London, (*Proc.* Phys. Soc., Vol. 20, 1906), the author described some experiments involving the protometric comparison of two glow screened with red and green glass respectively. The Lummer-Brodhun, Jolly and grease-spot photometers, which had previously been found to give concordant results for lights of the same color, gave utterly divergent results in this case, while the results obtained from each of the photometers depended upon the distance away of the eye from the photometrical surfaces.

The "yellow-spot" effect, as for shortness we may term it, is well known to those who have studied color photometry, but its importance from a practical point of view, is certainly not sufficiently realized. In the experiment referred to, in which fairly pure colors were used, differences of the order of over 100 per cent could be easily produced. Even when an Argand gas burner and an incandescent mantle were compared under the same circumstances, differences of more than 5 per cent were readily obtainable, while the writer has encountered differences between 20 and 30 per cent when comparing a mercury-vapor lamp with a carbon-filament lamp.

We must remember, too, that quite apart from the discrepancies in the readings of the various photometers, the sources of light which they compare will certainly be used to illuminate surfaces subtending a much greater angle at the eye than the surfaces in the photometers normally do, and that such protometrical tests may therefore fail to represent the illuminating power of a source in practice.

It may be remarked, however, that these effects are much more noticeable when the illumination of the photometer screen is low. There is, as we shall see later, a reason for this. Meanwhile it may be pointed out that, according to the author's experience, the difficulties of color photometry are reduced to a minimum by using a moderately high illumination of the photometer screen, of not less than about one candle-foot, and only become really urgent when the illumination is reduced below one candle-meter.

This question of the illumination of the photometer screen naturally leads us to the consideration of another allied color effect—the Purkinje phenomenon—which has been aptly termed "the nightmare of color photometry." For some reason the Purkinje effect is much better known than the yellow-spot effect. Yet, although both effects are now believed to have a common physiological basis, the Purkinje effect, in spite of its notoriety, seems to exert but little influence on photometry as ordinarily carried out.

By the Purkinje effect is meant that, with increasing stimulus, the luminous sensation produced by the red end of the spectrum increases more rapidly than in the case of the green end. The effect is now understood to be merely part of a more general physiological change which occurs in the behavior of the eye at low illuminations, and has been often illustrated by the following simple experiment:

Suppose we place two similar pieces of green and red paper and illuminate them with white light. The red will then in general appear the brighter of the two when the illumination is strong. But when the illumination is weakened, the red darkens more rapidly than the green, which soon appears unquestionably the brighter of the two. After this point the colors begin to fade, and eventually the green appears white and the red becomes jet black. If the illumination is weakened still further, the green, too, fades away into darkness. In order to show this experiment well, the colored surfaces must subtend a great angle at the eye; while if the angle is very small indeed, the colors fade away together and the Purkinje effect does not take place.

Modern physiological optics endeavors to explain these phenomena by the consideration of the functions assigned to minute light-perceiving organs scattered over the retina and known, from their appearance, as the "rods" and "cones" respectively. According to the modern theory of the action of these organs, which in its most complete form is attributed to the German physiologist Von Kries, the perception of color is associated with the *cones*. These organs are also believed to be most sensitive to yellow light, and, while inactive at very weak illuminations, continue to respond to increased stimulus, once they have started, long after the rods have ceased to do so.

The rods, on the other hand, are supposed to be unable to perceive color. All light, therefore, seen by means of the rods appears white, but the organs are most powerfully affected by light which is blue-green in character. The rods are also believed to be sensitive to very weak light at which the cones do not act; but with increasing stimulus they soon become, as it were, saturated and fail to respond any further.

At ordinary illuminations our vision is mainly carried on through the cone-organs and we see color. At very weak illuminations, on the other hand, only the rods are in action. We cannot distinguish colors properly and all objects appear a "ghostly" gray. As the illumination is increased, the cones suddenly begin to act. The colors appear and a struggle for predominance between the rods and the cones takes place. It is to this struggle that the Purkinje effect must be mainly attributed, though there are possibly other influences at work.

From a photometrical point of view, therefore, it is of interest to know at what order of illumination the struggle between the rods and cones has been decided in favor of cone vision. This question, however, is complicated by the peculiar distribution of the rods and cones over the retina. The extreme central portion of the retina contains practically only cones, and therefore if the image of the illuminated surfaces falls within this nearly rodless region, the Purkinje effect is absent, or at any rate very weak. If, however, the angle subtended at the eye by the illuminated surfaces is great, many rods are in play and by reason of their numerical superiority, exert an influence comparable with, and even greater than, that of the cones. The Purkinje effect is therefore accentuated.

In ordinary protometry the angle subtended at the eye by the illuminated surfaces is usually small and therefore the Purkinje effect does not become really noticeable until at very low illuminations; indeed, in the case of the author, well below one lux are reached. In practice, however, things are somewhat different. In street lighting, in particular, where the illumina-

tion is frequently very low, and where vast tracts of pavement and roadway have to be illuminated, the Perkinje effect cannot fail to be in evidence. Illuminometer measurements on the spot are therefore preferable to values calculated from the candle-power of sources as determined at ordinary illuminations, with which, indeed, they are frequently in disagreement.

The irregular distribution of the rods and cones over the retina also explains very satisfactorily the "yellow-spot" effect, since the variations in the relative brightness of two heterochromatic surfaces can be ascribed to the variation of the proportions of rods and cones on the portion of the retina on which they fall. Other explanations, however, have been suggested.

The physiological peculiarities of the eye which arise out of the behavior attributed to the rods and cones seems to be the chief difficulty in the way of accurate heterochromatic photometry. There are many points in dispute about these organs which are only imperfectly understood, however, and there are also other little understood minor peculiarities of the eye which affect the photometric comparison of sources of light differing noticeably in color.

We see, however, that there is no escape from these physiological color effects. Even if we could devise some method of photometrical measurement which was not affected by them we should still have to face their existence in practice, and the divergencies between the results of photometric tests and practical results would be greater than ever. The most satisfactory plan would perhaps be to fix, arbitrarily, the angle subtended at the eye by the photometrical surfaces, and the order of illumination at which the tests are to be carried out. Tests made on this system would possibly fail to represent the illuminating value of a source in practice, and would therefore have to be applied with caution, but they would at least be consistent among themselves.

Finally, a word or two may be said with regard to the various methods which have been devised to facilitate color photometry. Evidently no such method can get over the inherent difficulties of the subject, but only postpone them. Many of the methods are open to grave objection on other grounds.

One class of these methods involves the comparison of the integral brightness of the differently colored sources by utilizing certain portions of the spectrum only and ignoring the others. In the methods of Macé de Lépinay and Weber the two illuminated surfaces of the photometer were equalized, first when observed through a red and then through a green medium. The photometrical results of the comparison of the red and green components in the spectrum, so obtained, were then introduced into a formula for the comparison of the integral brightness of the two lights which, be it noted, depended on the observation of color effects by the deviser of the method.

Crova proposed to estimate the relative brightness of two heterochromatic sources by observation of brightness in the yellow region of the spectrum only. Apart from the experimental difficulties in the way of applying this method practically, it has much to recommend it, for unlike the previous one, it certainly utilizes the most valuable portion of the spectrum from the point of view of illumination.

But all such methods as those of Crova and Macé de Lépinay are open to one objection which limits their application very seriously. They are obviously only strictly applicable to the comparison of sources yielding a continuous spectrum. In the case of such sources as the mercury lamp, which yields a spectrum composed of isolated bright groups of lines, they break down entirely.

A method which has often been proposed, and which Dr. Lummer in his recent letter seems to approve, is the comparison, not of the power of creating brightness, but the power of revealing detail of a source of light. It has been urged, with a certain amount of justice, that what we chiefly desire from a source of light is this very power of revealing detail. Yet this is not invariably the case, and as the writer has suggested at the commencement of this article, tests undertaken with the object of determining the capabilities in this particular direction, must be regarded as additional, and not as a substitute for photometry proper.

Moreover, while feeling some trepedition in questioning the dictum of such an authority as Dr. Lummer, the author must confess that his own experience does not lead him to suppose that the "sharpness" of detail illuminated by colored light could ever be made the subject of a reliable method of photometry. For, apart from the seemingly inevitable want of sensitiveness of such a method, this "sharpness" seems to depend very greatly on the accommodation of the eye, which is not acromatic. The writer has already described some instances of the effect of this want of achromatism. We are virtually very shortsighted for the violet end of the spectrum. Therefore, while violet light is usually somewhat better than white light for the illumination of detail which is viewed at very close range, it is extremely bad for the illumination of objects which are to be viewed from a distance. *Red* light, on the other hand, is usually best for the illumination of distant objects.

A recent experiment shown by the author before The Physical Society of London to illustrate this effect, was as follows:

Two patches of pure red and blue light were thrown upon the screen, side by side, and the brightness of the red patch was so reduced that to all the audience the blue patch was clearly the brighter of the two. Nevertheless, when the two patches of light were used to illuminate a black and white chessboard pattern, the squares illuminated by the red light appeared quite sharp, while the squares illuminated by the blue light appeared indistinct and blurred, notwithstanding the fact that the blue light was of the stronger intensity. These effects are naturally affected by the optical peculiarities of the eyes of the observer, and are not equally evident to everyone. Indeed, the author has even met with some cases of observers who declare themselves unable to see any difference between the sharpness of the red and blue, under the conditions described above, and whose eyes were presumably either exceptionally well achromatized or capable of an exceptional degree of accommodation. But this only emphasizes the difficulty of devising any system of photometrical measurement dependent upon acuteness of vision. In any case results obtained with a photometer in which near vision is utilized would certainly be found inapplicable to the appearance of illuminated detail viewed at a distance of a few meters. When we remember, too, that the addition of light of an undesirable frequency may, while increasing the *brightness* of illuminated detail, actually render it more difficult to distinguish, the desirability of keeping any such method distinct from ordinary photometry is obvious.

Finally, mention may be made of a type of instrument which has recently attracted some attention, namely the flicker photometer of Rood. From what has been said it will readily be understood that whether the flicker photometer is affected by the usual color phenomena or not, it cannot be expected to give consistent results with photometers of the equality of brightness pattern, which differ among themselves so greatly when the comparison of sources of light which differ in color is attempted. As a means of avoiding the natural difficulty of forming a judgment of equality of brightness in the case of lights of different colors, this type of instrument has certain advantages. On the other hand, while the claim that this instrument is independent of all color effects, such as the results of color-blindness, for instance, certainly cannot be substantiated, there is good reason to believe that the influence of the peculiar behavior of the rods and cones is less evident in instruments of the flicker class. Yet it is very doubtful whether this is to be regarded as an advantage, and whether the instrument is not open to objection on physiological grounds for this very reason. The author has made some experiments on this point, the results of which he hopes to publish shortly. A complete investigation into the theory of the flicker photometer, especially from the point of view of reconciling its behavior with the theory of the rods and cones, is very much to be desired, and no doubt the research which Dr. Lummer is undertaking on this point will afford very valuable information.

Meanwhile a more general acquaintance with the physiologi-

cal peculiarities of the eye as regards the perception of color is greatly needed. The requisite knowledge, which would enable the illuminating engineer to cope with the difficulties which are inseparable from the use of colored light, is almost entirely confined to physiologists, and is rarely available in a form which is applicable to actual problems of illumination. Many of the chief experimental results of the past, too, are the work of only a few, and how far they are applicable to the normal eye, and how greatly the eyes of different individuals differ amongst themselves, has never been satisfactorily determined. The time is now fast approaching when the illuminating engineer will be driven to consider these color phenomena more thoroughly. We have yet much to learn as to the possible uses of light from different portions of the spectrum, and we have yet to contrive satisfactory and universally recognized methods by which the value of these portions of the spectrum for special purposes, can be measured.

Rubber Insulation for Conductors—II.

BY FRED J. HALL.

In the first part of this article, published last week, para rubber and its properties were considered and some tests given for rubber used for the insulation of electric wires and cables. In the present and final part other tests are described.

STRETCH TEST.

There is no test to which rubber insulation is subject about which there are such wide differences of opinion as the stretch test. Elasticity is the most obvious property of crude rubber; its other properties are far less apparent. Elasticity being so obvious it has been assumed that good ruber compounds are elastic, and that poor rubber compounds are not. Any rubber compound, good or bad, is at one stage of manufacture a plastic mass of about the consistency of putty. Strength and elasticity is given this plastic mass by vulcanization. Precisely the same compound can, by changes in the quantity of sulphur and method of vulcanization, be made highly elastic or as brittle as glass. Lack of elasticity in a vulcanized rubber compound is, therefore, no proof of inferiority.

In the first part of this article attention was called to the most esential properties of rubber considered solely from the standpoint of insulation: 1. Non-hydroscopic; 2, dielectric; 3, mechanical strength; 4, elasticity.

As all grades of rubber are non-hydroscopic, this quality need not be considered. It is evident that dielectric property and mechanical strength are the most important factors from an insulating standpoint. A substance lacking these qualities, though possessing great elasticity, would be useless as an insulator. The question then is, by what process of manufacture can these qualities be developed to their highest point. The following illustration will throw light on this point.

Take two copper rods and cover them to the same thickness with the same compound. By the process already outlined, vulcanize one so as to bring out the elastic property of the compound to its highest point, and the other until the compound is brittle or hard rubber. The latter will give a higher insulation resistance, will last indefinitely, possess greater tensile strength, and withstand very much greater electrical stress without rupture. From an electrical standpoint every advantage will lie with the non-stretching compound. Hard rubber, however, is useless as an insulator for electric wires and cables for a purely mechanical reason—it will crack when bent. It is obvious, therefore, that the most efficient rubber insulation is one in which dielectric property and mechanical strength have been developed to the highest point consistent with the retention of sufficient elasticity to enable the insulation to stand, without injury, the bending necessary for manufacture and installation.

The following questions are sometimes asked, and it is wise to anticipate them:

Can a very low-grade rubber compound be so vulcanized as to meet the ordinary stretch tests? No.

Does not the stretch test, therefore, prevent the use of a very low-grade rubber compound? It does.

It should be added that such a compound would not meet the maximum acetone test already mentioned, nor would it be likely to meet the electrical tests. In other words, there are tests besides that for elasticity which adequately ensure the purchaser against the excessive use of low-grade rubbers. This being a fact, it is certainly unwise to insist on a test that forces the manufacturer to sacrifice qualities in his compound essential to a high factor of safety, and it is certainly unjust to exact a guarantee from him under such conditions.

It is sometimes stated in justification of the stretch test that it is simple and easily made, requiring only a sharp knife and a rule, whereas the ash and acetone tests must be made in a laboratory with apparatus more or less complicated and by one possessing some technical ability and knowledge of chemistry.

It is a mistake to consider the stretch test so simple that any one can make it. There are several important factors affecting this test which do not receive proper consideration.

Temperature.—Cold hardens rubber, lessening its elasticity. The test should be made at a normal temperature—say, between 50 deg. F. and 70 deg. F.

Cutting.—Rubber is one of the most difficult substances to cut evenly. The sample must be the same width and thickness between the points to be stretched, to properly test its elasticity and return. Minute incisions on the edge of the sample are difficult to avoid, and will materially affect this test.

Stretch and Release.—All rubber compounds have a certain set which if violently overcome by a sudden, jerky movement, causes minute ruptures, seriously affecting both stretch and return. The stretching should be done steadily and not too fast, and the release instantaneous from both ends. Holding the sample at a tension even for a short time will affect the period of its return.

One minute should be allowed for the sample to return. If absolutely perfect conditions were always obtainable, a much shorter period would answer, but one minute is only a fair allowance to cover variations in the conditions under which the test is made.

As the sacrifice of the most important qualities of rubber insulation to the least important—elasticity—can sometimes be made without danger, few manufacturers object to meeting the stretch test when aplied to thin insulation on small sizes for low pressure. There are sound reasons, however, why the stretch test should never be applied to the insulation on large conductors or to thick insulation for high pressure, irrespective of the size of the conductor.

The factors of time and heat in vulcanizing should be regulated by the mass to be vulcanized. This mass on large conductors, or when thick walls are used, is so great that it cannot be properly vulcanized without a sacrifice of elasticity sufficient to make the ordinary stretch test impossible. When the outer surface of the outer layer of a thickly insulated conductor has been vulcanized to a point where the elastic property is greatest, the inner layers, particularly the portion lying next to the conductor, is undervulcanized. It is undisputed that a rubber compound undervulcanized is highly perishable. *Another important point is that the principal contributors to the factor of safety in rubber insulation for high tension are firmness and density, both of which are antagonistic to stretch. Specifying a stretch test for high pressure rubber insulation invariably means reducing the factor of safety.*

On the smaller sizes, say, up to No. 4 B. & S., and for walls not over 4/32 in. thick, for low pressure, there is no danger in the enforcement of a reasonable stretch test. Nearly all manufacturers will agree to meet it, not always because they consider it desirable, but because their customers wish it. In determining just what stretch test shall be required, the writer feels justified in again calling attention to the fact that most specifications are based upon unreasonable premises. The purchaser takes the maximum result to be obtained under perfect conditions, and expects the manufacturer always to duplicate these conditions and results in his factory. Specifications

should be drawn and interpreted as broadly as is consistent with the retention of the essential features of the various tests.

For small sizes and thin walls, as indicated above, the following stretch test would give all the assurance of a good compound that such a test could possibly give. A 4-in. sample cut from the conductor to have marks 2 ins. apart placed on it. The sample to be stretched until the marks are 6 ins. apart. The return to be to 2½ ins. For larger sizes and heavy walls, a sample cut from the conductor, containing the full thickness of the insulation, to be bent double and the process repeated in reverse, without any signs of cracking.

TENSILE STRENGTH TEST.

Any good ruber compound properly vulcanized will have a tensile strength of 800 lbs. to the square inch—the usual requirement. Objections to this test cannot, therefore, be based on its being excessive. In making this test the same difficulty exists as in the cutting of the sample as in the stretch. The strain being greater, any fault in cutting the sample will affect the final result much more seriously. The only result obtained by this test is the approximate tensile strength of the sample tested; it is mere assumption that the same strength exists along the entire line of insulation. If there is any reason for this test, it must be to ascertain the mechanical strength of the insulating compound, and this can certainly be much better accomplished by the application of a disruptive force along the entire line of insulation. This is done by voltage, and when an adequate pressure test is applied the retention of a tensile strength test seems unnecessary. Its abandonment would work no injury to the purchaser, and save the manufacturer the injustice and loss which he is likely to suffer in submitting to a test, the results of which may or may not show the real strength of the compound.

Both this test and the stretch test should be made at the factory and in the presence of the manufacturer or his representative, and the goods accepted or rejected on the test there made. Few manufacturers have escaped the unpleasant experience of having their insulation pass these tests at the factory and later received notice of rejection because samples of insulation taken from the factory have failed to pass. The manufacturer is certainly entitled to see that the tests are accurately made and under proper conditions, otherwise he may be subjected to loss and trouble arising from the carelessness and incompetency of the inspectors. In fairness to the latter it should be said that a majority of the inspectors understand their duties quite as well as the manufacturer, but the trouble is that a single careless or incompetent inspector, visiting the different factories, can stir up considerable of an insurrection and in a short time have the purchaser and the manufacturer at loggerheads.

INSULATION RESISTANCE.

Judged by their specifications, many purchasers of insulated wires and cables firmly believe that high insulation resistance means high-grade compound; also ability to withstand electrical stress. Both assumptions are erroneous. There is no direct relation between insulation resistance and pressure. If a number of lengths of the same cable are being tested, and one length has an insulation resistance considerably below the average of the others it will probably break down at a lower voltage than the others, this, however, is due solely to some structural fault or mechanical injury. It is well known that a cheap compound can be made to give high insulation resistance; also that a compound giving a comparatively low insulation resistance will often stand a greater voltage without rupture than one with a much higher insulation resistance. The qualities in a rubber compound that affect these tests are not identical.

No one will deny that only a small fraction of the insulation resistance required in a test is necessary for practical purposes; the excessive requirement is simply to provide a factor of safety in case of deterioration in the dielectric property of the insulation. Under certain conditions the insulation resistance increases with age, owing to the drying out of the insulation, as there is always more or less moisture in all newly made rubber compounds.

Many purchasers take the maximum insulation resistance obtainable for a certain size conductor and wall of rubber, and make that the minimum requirement. They ignore the obvious fact that *absolute uniformity* in mixing and applying the compound and in handling it during the various processes of manufacture is impossible. It has never been attained in any manufactured article, except the wonderful one-horse shay. No two links in a chain are *exactly* alike in texture and strength. The important point is that there should be an ample factor of safety for the service required in the weakest link. It should also be borne in mind that rubber compounds, even when containing the same percentage of para, vary in their specific insulation resistance. This is due to variations in the ingredients other than para and to the method of treatment. In other words, insulation resistance is variable, and in specifying it the object should be to establish a minimum test that would ensure reasonable uniformity in manufacture, while giving an ample factor of safety. This test should be the same before and after the application of pressure, as there may be structural faults that can only be developed by the application of voltage.

The question naturally arises, how can such a minimum insulation resistance test as has been suggested be established? The National Board of Fire Underwriters require for a No. 14 B. & S. with 3/64-in. wall of rubber insulation, 200 megs. after 10 hours' immersion at 60 deg. F. Telephone companies for the same size and wall of insulation require 500 megs., 24 hours immersion at 60 deg. F. For this size conductor and wall of rubber, 200 megs. is ample for all practical purposes, but recognizing the prejudice that exists in some quarters in favor of high insulation resistance tests, suppose we multiply the telephone requirements by three (3) and establish 1500 megs as a basis. This should satisfy the most ardent advocate of high insulation resistance. With this as a starting point the insulation resistance of for any size conductor and wall of rubber can be ascertained by the use of the well-known formula:

$$Constant = \frac{Resistance}{log \frac{D}{d}}$$

$$Resistance = Log \frac{D}{d} \textit{ multiplied by constant.}$$

TEMPERATURE COEFFICIENT.

The variation in insulation resistance due to temperature changes is 2.6 per cent for each degree Fahrenheit. Thus, a difference of 27 deg. F. above the temperature at which the test is made will reduce the insulation resistance by one-half, and the same change below the testing temperature will double the insulation resistance. For high temperatures the percentage of change for each degree Fahrenheit is slightly greater than 2.6, but this figure can safely be used between 40 deg. F. and 70 deg. F. As this allows for a variation of 30 deg. it is ample for all practical purposes.

VOLTAGE TEST.

There is no test so important in determining the practical efficiency of insulation as the voltage test. It has already been stated that there is no direct relation between insulation resistance and ability to withstand electrical stress; it follows that an insulated conductor may have low insulation resistance, but work satisfactorily if there is sufficient strength in the compound to withstand the maximum working e. m. f. Reverse these condtions and the cable is useless. Excessive test voltages should be avoided as they strain the insulation, thereby weakening and shortening its life.

A test of two and a half times the maximum working e. m. f. for five minutes after 24 hours immersion, or for twice the maximum working e. m. f. for 30 minutes, will not strain the insulation, but will develop any structural faults and establish the existence of an ample factor of safety.

When the voltage is nominal and the walls of insulation comparatively thick, as in the case of signal wires and cables, a voltage test based on two and a half times the working e. m. f.

would evidently be inadequate. When these conditions exist the engineer drawing the specifications should determine the maximum working e. m. f. which he would be willing to use on the conductor and wall of insulation in question, and base the voltage test on this. As an example: A No. 14 wire with 5/64-in. wall of rubber could safely be used for 2000 volts alternating e. m. f. The test, with two and a half as the factor, would be 5000 volts for five minutes, or 4000 volts with two as a factor, for 30 minutes, although the actual working voltage might be merely nominal.

This rule may lack scientific exactness, but it is simple and adequate. No insulation successfully tested under this rule could have either structural faults or inherent weakness sufficient to endanger its successful operation. The object of a voltage test should be not to determine the greatest stress to which the insulation can be put, but to establish the existence of a safety factor. Break-down tests, except on a sample, are dangerous. There is always a point, other than where the puncture takes place, where the excessive strain has caused a weakening of the insulation; there may be several such points. These weak places will in the course of time give trouble, whereas the same cable, if tested merely for the purpose of establishing an ample factor of safety in the insulation under maximum working conditions, would have continued in successful operation indefinitely.

BRAID AND TAPE.

There is an erroneous impression that a rubber-filled tape or a weatherproof braid increases the insulation resistance. Numerous experiments have shown that these have no effect whatever on the insulation resistance after a short immersion. A tape or a braid is an important protection to the insulation, particularly while it is in the plastic state preceding vulcanization. With large conductors and whenever thick walls of insulation are employed, irrespective of the size of conductors, the application of a tape before vulcanizing is particularly desirable—almost necessary—to good work. The process of manufacture in some factories is such that it is convenient to have the test made, particularly on the small sizes—before tape or braid is applied. This is never, however, a desirable method of testing, and to require it under all circumstances imposes a dangerous and troublesome condition on the manufacturer, from which the purchaser derives no benefit whatever. Moreover, the purchaser is not interested in the condition of the goods when partially manufactured, but in the condition in which they will be used. If tested plain, *i. e.*, without tape or braid, what assurance has the purchaser that the insulation has escaped injury when being taped, or braided and waxed? None whatever, unless the tests are repeated, which means doubling the cost of inspection and delaying shipment. With leaded or armored cables and with multiple conductors double testing is necessary, but single conductors, when neither leaded nor armored, should be tested only in the completed state.

CHOICE OF A COMPOUND.

In considering the foregoing tests the writer has already called attention to the fact that he had in mind a 30 per cent para compound. Enough has been said to show that rubber compounds of high practical efficiency can be made in which lower priced rubbers enter either in part or in whole, and that difference in price is not a fair indication of difference in quality.

The principal arguments in favor of using a 30-per cent para mixture probably are, first, that being a standard it is likely to run more uniform in quality; second, that having been long in use it has had more opportunities to prove its virtue under trying conditions than most rubber compounds; third, that in case of trouble, the party responsible for the installation would be subjected to less severe criticism if a standard insulation is used.

Without stopping to take up the real value of these considerations, it is sufficient sometimes to justify the additional expenditure necessary to secure a 30 per cent para mixture. The following indicates the conditions under which 30 per cent para might be specified: For high pressure, 10,000 volts alternating and over; all submarine work; when conditions of service are exceptionally severe.

When the nature of the compound is not specifically stated, the tests for 30 per cent para outlined in this article must be modified. Such modification does not necessarily imply a lower practical efficiency for the conditions of service, it simply means that not being the same compound as 30 per cent para, it is impossible to get the same result from all tests. Probably no two manufacturers make their high grades, other than para, exactly alike. There are differences in the quantity and quality of the ingredients, both organic and inorganic. The methods of treatment during the processes of manufacture are not the same. The specific insulation resistances of the compounds may vary as much as 50 per cent. This does not mean that there are the same variations in practical efficiency, but merely that the manufacturers travel somewhat different roads to reach the same destination.

The difficulty of fixing definite tests to meet these variations in the compound is evident. The purchaser's main reliance should be on the reputation of the manufacturer, his guarantee, and on the electrical tests; the insulation resistance to be at least 50 per cent of that required for a 30 per cent para compound and the pressure test the same. If the purchaser does not feel sufficiently safeguarded he could add the following:

Acetone test.—Not over 8 per cent extractive matter.

Ash test.—Same as for 30 per cent, viz., not over 68 per cent nor less than 56 per cent.

Elasticity test.—The same as required for large sizes and heavy walls of 30 per cent, viz., sample to be bent double, and the process is to be repeated in reverse, without cracking.

Such tests would afford ample evidence of the efficiency of the compound.

RECLAIMED RUBBER.

A manufacturer of insulated wires and cables writes these words with a shudder and speaks them in a whisper, because to the purchaser's mind they stand for all that is dangerous in the insulation. Long ago the manufacturer learned that the judicious use of reclaimed rubber in conjunction with raw rubber of all kinds, distinctly improved his compounds. He has not dared to breathe this secret, however, for fear of being blacklisted.

Mineral matters used in rubber compounds have little dielectric property. They are inert, and their mixture with the rubber is almost entirely mechanical, little real assimilation takes place. They give body to the rubber, but otherwise may be considered cheap adulterants. Whereas good reclaimed rubber when properly treated has considerable mechanical strength, high dielectric property and long life. It is thoroughly assimilated by the raw rubber and can be purchased at a price which enables the manufacturer to substitute it for a portion of the cheaper and comparatively useless mineral matter without placing an exorbitant price upon his goods. Like many excellent things, it is the abuse, not the use of reclaimed rubber that is bad. The important point is that the percentage and quality of raw rubber called for is used. The writer has no hesitation in asserting that even if a manufacturer were willing to risk his reputation, and loss under his guarantee, by the excessive use of reclaimed rubber, he could not do so and meet the specifications outlined in this article. It is time that the value of reclaimed rubber became as generally understood as is the danger arising from its excessive use. It has too long been held up as an object of scorn and derision. It might be mentioned incidently that if reclaimed rubber had not come into existence, the cost of all articles into which rubber enters would be so high that serious consequences would result.

FREE SULPHUR.

Reference has been made under the acetone test to free sulphur. The writer realizes that considerable difference of opinion exists as to the effect of free sulphur on a vulcanized rubber compound. For this reason the following points may be of interest:

Weber in his "Chemistry of Rubber" says: *"Free sulphur only becomes objectionable if its amount exceeds certain limits. Excess of sulphur may cause an efflorescence, technically termed 'sulphuring up,' on the vulcanized surfaces which, although objectionable from the point of view of appearance, does not affect the soundness of the vulcanization."*

Weber does not define what he means by "certain limits," but the fact that when there is enough free sulphur to "bloom" on the surface does not injure the compound, it would seem that a much higher percentage than is present in most insulating compounds may exist before the "objectionable" point is reached.

The writer has seen an analysis of rubber insulation stripped from a cable that had been in successful operation for about nine (9) years and is still working, that showed about 2 per cent of free sulphur. The compound was a high grade para mixture and it had retained its strength and resiliency without any apparent deterioration.

A chemist who has devoted a great deal of time and study to rubber and its compounds, stated in conversation that he regarded free sulphur in much the same light as the ordinary mineral adultrants. That a slight increase was no more and no less harmful than a similar increase in talc or the well-known oxides used in dry mixtures. This may be a somewhat radical opinion, but coming from one who has studied the matter, it is worthy of consideration.

Attention should be called to one of the many eccentricities found in the vulcanization of rubber. Assume that a certain compound properly vulcanized has originally contained 3 per cent of sulphur, and that 1 per cent remains free. A natural assumption would be that only 2 per cent of sulphur was necessary, and if this amount was used, the same vulcanizing result could be obtained and the presence of free sulphur avoided. This is far from true. Free sulphur would still be found. This would show that a smaller quantity of sulphur had combined with the rubber, indicating improper vulanization and a perishable compound. In other words the right chemical combination between sulphur and rubber, does not take place except in the presence of an excess of sulphur, and that a certain amount will always remain free. It is a mistake for specifications to limit this amount. A manufacturer can have no reason for using more sulphur than his experience has shown him is best adapted to his compounds and method of treatment.

Perhaps one of the greatest dangers from an excess of sulphur is overvulcanization, unless the factors of time and heat are carefully watched. Weber's comments on this subject are interesting (Page 285)—*"Undervulcanized articles are much more prone to decomposition than overvulcanized ones. Indeed, I have never yet seen a case of decomposition due with certainty to overvulcanization."* It might be remarked incidentally, that there is infinitely greater danger of undervulcanization, in a highly elastic rubber compound, than in one where the process has been allowed to proceed until the compound has assumed a firmness that will not permit of the ordinary elasticity tests. Indeed, in this latter case the danger of undervulcanization is entirely eliminated.

SPECIFICATIONS.

Specifications for rubber-insulated conductors considered in their general form rather than in relation to the details of their requirements, exhibit two striking characteristics.

1. These are one-sided. The manufacturer agrees to everything, the purchaser to nothing except to take and pay for the goods provided they meet the specifications, *as he chooses to interpret them.* There are so many conditions which may affect the results obtained from the various tests, that the writer will agree to turn down any rubber-insulated conductor submitted to him, made under the average specification, and do so with every appearance of honesty. No specifications can be interpreted with hair-splitting exactness, some breadth of intelligence is necessary. The main object of specification should never be lost sight of, namely to assure the purchaser that he is getting goods that will in every respect meet the service requirements satisfactorily. If he is assured of this, it is the essence of folly and injustice to reject goods because they fail in some slight degree to meet every test to which they are subjected.

2. The purchaser displays in his specifications painful evidence of a lack of confidence in the manufacturer. It must be admitted that the manufacturer himself is largely to blame for this. Lack of knowledge begets suspicion. The purchaser seldom has more than a very superficial knowledge of practical cable making, nor can he acquire it except through a manufacturer. When he has sought for it in this way, he has sometimes been given only such information as tended to magnify the virtues of the compound favored by the manufacturer whose advice was requested. Now the average purchaser is just as honest and just as intelligent as the average manufacturer, he will soon discover that the latter always has an "ax to grind" and will therefore accept his advice "cum grano salis." The purchaser's faith in the manufacturer is lessened instead of increased, and this is reflected in the production of specifications more unreasonable and impractical than ever, and in a more rigid enforcement of them. Fortunately few manufacturers now follow this course, so few indeed that it would not be wise to mention the number. The trouble they have had, and are likely to have in the future, would be pleasant to contemplate were it not that they involve others as well as themselves.

In conclusion the writer wishes to emphasize the fact that in the exact proportion that the manufacturer can gain the confidence of the purchaser by offering honest and disinterested advice, and prove its worth by giving insulation of high practical efficiency, will the latter be guided by this advice, and unreasonable and vexatious specifications disappear.

New Telephone Patents.

AUTOMATIC EXCHANGE DEVICES.

A patent granted to F. A. Lundquist, of Chicago, refers to a sender dial for automatic exchanges. This is one adapted to a special numbering system. With this system all numbers begin with 100, which digit is set up by giving the pointer any indeterminate movement and allowing it to return to neutral. The tens digit is set up definitely and the pointer released and then the units. Then a group number is set up by means of an auxiliary push-button. This last corresponds to the hundreds. Thus a telephone known in the normal numbering system as 247, by this system would be 147—2; 521 would 121—5.

Another patent concerning automatic exchanges is one issued to S. A. Norstrom, of Chicago. This relates to means for preventing the sticking of the operating magnets between impulses. These magnets are polarized and will be de-energized by a momentary reversed current which will neutralize any residual magnetism. The present patent describes an arrangement of a condenser and relay bridged across the mains. When a normal current impulse ceases, the condenser discharge momentarily operates the auxiliary relay, the contacts of this latter connecting a reversed battery momentarily to the mains.

COMMON-BATTERY CIRCUIT SYSTEM.

Mr. F. W. Dunbar, of Chicago, has patented a common-battery switchboard circuit system wherein the supervisory signals are controlled by a differential relay. At the subscriber's stations with the hook-switch down, the bell is legged off one side of the line to ground. As the two windings of the supervisory relays are connected in parallel with their respective corresponding repeating coil windings, they will receive neutralizing current with the hook-switch up. When the hook is down, but one winding receives current and there is, therefore, no neutralization. With this type of relay it is necessary to place the two windings upon opposite ends of the core so that their impedance to telephone currents will be retained notwithstanding the differential connection.

SWITCHBOARD LAMP.

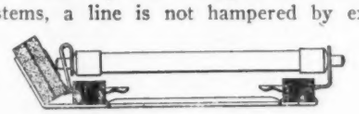
Switchboard lamps of recent manufacture have practically all been of cylindrical shape with terminal strips secured to

them as a sort of holder. These lamps fit into lamp sockets to a depth such that their ends are within the socket. A lamp cap of approximately hemispherical shape closes the socket and serves as a bull's-eye.

A new design of lamp has been patented by Herman Boehm, of Youngstown, Ohio. This has the usual cylindrical body and terminals, but the lamp is elongated and its front portion is expanded into a button the shape of a lamp cap. This serves at once in this capacity and at the same time forms a limit stop for the lamp.

PROTECTORS.

Some time ago we noted a cable terminal, the invention of Frank B. Cook, of Chicago, which was arranged with removable protector units. By this arrangement, with multiple distribution systems, a line is not hampered by extra arrester



TELEPHONE PROTECTOR.

springs at each multiple point, one set being shifted from point to point as occasion demands. Mr. Cook has now obtained a patent for the protector unit for such a cable head. This unit comprises a sheet metal base carrying an insulating block at each end and spring clips to hold carbons and fuses and to afford terminal joints. A side view of the unit is shown in the figure.

Another patent to Cook covers a test and restoring plug for a special use of his heat-coil protectors. Like the earlier ones, this affords a means of restoring the disrupted parts after operation, the application of an abnormal current to heat the coil, and means for cutting off automatically the heating current as the parts come home into set position.

INTERCOMMUNICATING SYSTEM.

Mr. W. W. Henry, of Wollaston, Mass., has patented a special set for an intercommunicating system. A series of switch buttons are mounted in the box, each bearing a legend showing its station. To make a call, one is selected and depressed and then the ringing key is depressed, and the desired station rung. After conversation, the restoration of the receiver hook resets everything to normal.

LETTERS TO THE EDITORS.

Long Distance Wireless Telegraphy.

To the Editors of Electrical World:

SIRS:—The remarks of Dr. Lee de Forest in your issue of Nov. 16, concerning the recent observations of the writer with reference to antipodal wireless telegraphy, have been noted with interest. As it appears that Dr. de Forest failed to grasp the substance and spirit of the letter of the writer published in your issue of the 9th inst., it is presumed that he did not carefully read it or that its contents escaped his memory before he wrote his comments.

The unconfirmed report that a wireless message had been received from Manila at the Marconi station at Glace Bay was recorded as a mere incident, with no significance other than that of having suggested the thought concerning the probable existence of maximum electromagnetic effort at a point antipodal to the source of the waves, assuming that their initial intensity was sufficient for transmission to the terrestrial equator with respect to the sending station.

It would indeed be a powerful station and a remarkable system which could effect such a long transmission, but a contemplation of the successful trans-Atlantic transmission on a commercial basis, now being accomplished by Marconi, lends an optimistic prospect for substantial progress in long-distance wireless transmission of intelligence.

The writer did not fail to take into consideration the "losses" in transmission as stated by Dr. de Forest, as it will be observed that he remarked that "the actual intensity would, of course, be much less than that at the sending station, owing to the dissipation of energy in transmission."

In conclusion, I would suggest that Dr. de Forest's reference to the psychological moment may be properly applicable to the source of the report concerning the Manila-Glace Bay transmission.

CHICAGO, ILL. ERNEST F. SMITH

Standard Wiring Symbols.

To the Editors of Electrical World:

SIRS:—The attention of those who draw up lighting and wiring specifications cannot be too strongly directed to the set of standard symbols issued by the National Electrical Contractors Association, and recently printed in your columns. These symbols were prepared after a careful canvass of the ideas of the various people having a practical interest in the subject, and have been officially adopted by the American Institute of Architects and the above-mentioned association—the two bodies most directly interested in the matter of such symbols. There is certainly no good reason for clinging to the miscellaneous methods of notation that have heretofore been in vogue, when standard symbols answering all common requirements have been sanctioned by such authority. Charts of the symbols, and sheets for inclusion in specifications as explanatory of the standard symbols used in with drawings, may be obtained at a nominal cost by addressing the secretary of the National Electrical Contractors' Association, Utica, N. Y.

CHICAGO, ILL. T. L. ARMSTRONG.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Single-Phase Series Motor.—An illustrated description of a single-phase series motor of the Oerlikon Company. It has

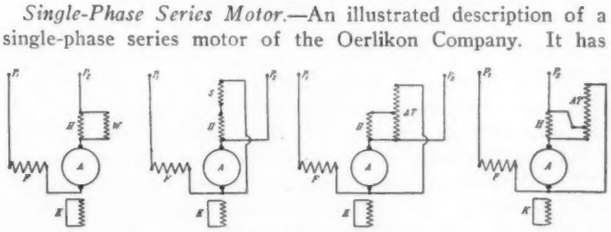
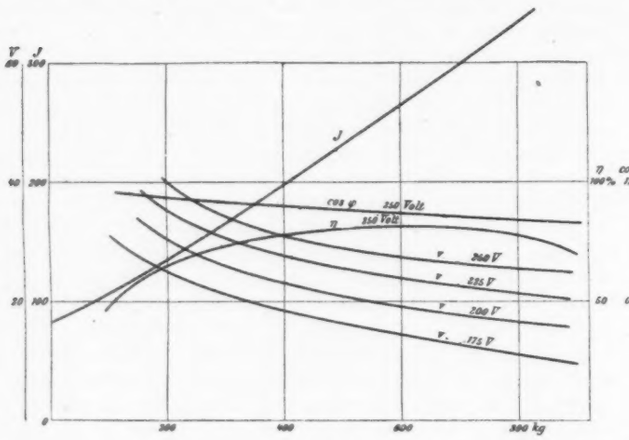
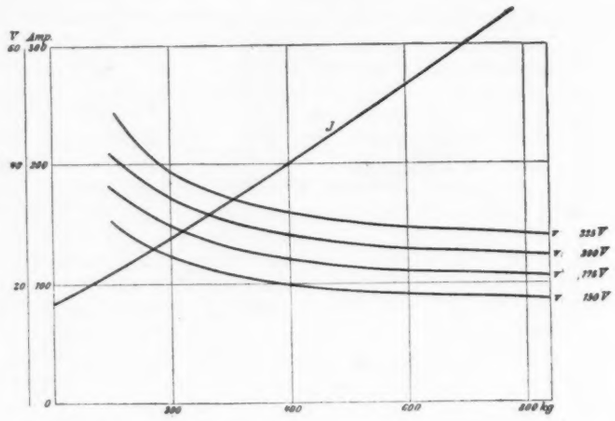


FIG. 1.—SINGLE-PHASE SERIES MOTOR.

been developed in four different types, which are illustrated in the four diagrams of Fig. 1. *A* represents the motor armature, which is provided with a commutator and brushes. *F* is the stator winding, which produces the magnetic field and is connected in series with the armature. *K* is the stator winding which compensates the armature m. m. f. This so-called compensation winding is shown in the diagrams as short-circuited, but it could be connected in series with *A* and *F*. *H* is the stator winding for improving the commutation, or the so-called commutation pole winding. In the first diagram *H* is in parallel with the resistor, *W*, and this combination is in series with the armature. In the second diagram, *H* is in series with an inductance coil, *S*, and the two are in parallel with the armature. In the third diagram an autotransformer, *AT*, is made use of, while the fourth diagram shows a combination of the first and third. Drawings are given of a motor built on this principle and used for electric traction. On account of the narrow gauge it had to be carefully designed to utilize fully

the available space. The motor normally consumes about 250 amperes at from 225 to 250 volts and 20 periods; the ratio of gearing is 1 to 5.15. The motor runs absolutely sparkless up to 300 amperes during starting, as well as at any speed. A continuous load of 60 horse-power at 250 volts for one hour gave temperatures which are below the limits required by the regulations of the German Association of Electrical Engineers. When the compensated winding is in series with the armature and field circuits the motor may be used as well with direct current as with alternating current. Fig. 2 gives the results of tests of the motor with alternating current; Fig. 3 gives the results of tests of the motor with direct-current. The curve J is the current for all voltages, while the curves v give the speed in kilometers per hour. The ordinates are the tractive force at the periphery of the wheel in kilograms. Fig. 4 shows the behavior of the motor at starting, both for direct current and alternating current. The alternating-current curves are given in drawn-out lines, while the direct-current curves are given in dotted lines. The motor is used on the Locarno-Pontebrolla-Bignasco Road,





FIGS. 2 AND 3.—RESULTS OF TESTS OF SINGLE-PHASE SERIES MOTOR.

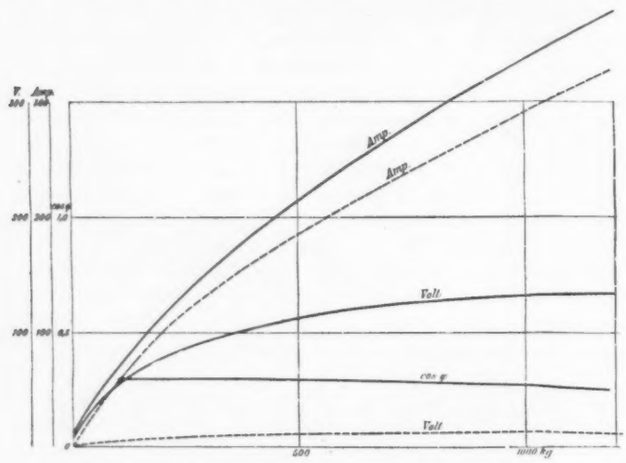


FIG. 4.—BEHAVIOR OF MOTOR AT STARTING.

which has at present three passenger cars, each being equipped with four motors of this type. The operating e. m. f. is 5000 volts.—*Elek. Zeit.*, Nov. 7.

Commutation.—C. L. R. E. Menges.—A theoretical article on the phenomena of commutation. The author strongly objects to the generally accepted view that in order to get sparkless commutation the short-circuited coil should not be in the neutral zone, but that the brushes should be displaced until the coil comes into a magnetic field of proper intensity. The author considers this view to be wrong, and claims that perfect commutation takes place in the neutral zone. The fundamental principles of his view are explained at length. The same number contains two letters by E. Arnold and A. Ruedenberg on the same subject. They take the opposite view.—*Elek. Zeit.*, Oct. 31.

Power.

Gas Engine Efficiency.—B. Hopkinson.—A note on a paper read before the Institute of Mechanical Engineers in London. The author deals with the report of the committee of the Institution of Civil Engineers on the efficiency of internal combustion engines. This report stated that, in the case of gas engines, indicator diagrams did not give as accurate results as was generally supposed. Tests described by this committee supported this view, and the mechanical losses were, therefore, obtained by running the engine light and estimating the indicated horse-power under these conditions. This value was added to the brake horse-power at full-load, and the sum was taken as being the true indicated horse-power. Having regard to the widespread effect that this view would have on already published efficiency tests, the author undertook some investigations to determine whether the indicated horse-power of a gas engine is so variable a quantity and so difficult to determine as the committee suggested. The paper contains the results of some tests made, with this object, on a 40-hp Crossley engine and on an engine belonging to the Daimler Company. From the results obtained, the author draws the following conclusions: (1) That if precautions are taken to keep the gas supply constant the diagrams given by the engine are very regular, whether the engine be missing ignitions or not, and they afford a measure of the indicated power correctly to within 2 per cent. (2) That the difference between indicated horse-power and brake horse-power is rather less than the horse-power at no-load under the same conditions of lubrication, owing to the difference in power absorbed by pumping. The friction is constant if the temperature of the cylinder walls is kept the same, but is very dependent on this temperature.—Lond. *Electrician*, Nov. 8; the full paper is published in Lond. *Elec. Review*, Nov. 7.

Large Gas Engines.—An account of tests of two 1400-hp gas engines operated with brown-coal producer gas in a German metallurgical works. The tests gave a consumption of 3385 "heat units" per kw-hour. With an efficiency of the electric generators of 75 per cent and with a mean calorific value of 5000 heat units of the brown-coal briquets per kg, one kw-hour requires 0.9 kilograms of brown-coal briquets. At a price of $2.38 per ton at the works, the cost of fuel per kw-hour is only 0.214 cent.—*Elek. Zeit.*, Nov. 7.

Electric Cranes.—H. H. Broughton.—A continuation of his long serial. In the present installment the author deals with the important question of the rating of motors for crane work. The ratio between the working at full-load in the time occupied for a complete cycle of operations and the time of the cycle itself is termed the "load factor," and this method of rating is explained. A comparison is also given showing the misleading results obtained by the usual method of specifying a full-load test for a certain period. Tables referring to motors of English make are given in explanation of these points.—Lond. *Electrician*, Nov. 8.

Motors.—J. T. MOULD.—A paper read before the Association of Egineers-in-Charge on the starting, regulating and stopping of continuous-current motors. The construction of starting switches and the proper dimensioning of the steps is discussed and rules are given on the best type of motor and the best method of control for driving different kinds of machines.—Lond. *Electrician,* Nov. 8.

Traction.

Tube Railways in London.—A table giving details of the financial results of the various tube railways in London. From a comparison with tramway returns, it would appear at first sight that very satisfactory results should be obtained, since the cost of working in no case exceeds 14 cents per car-mile, and in one case falls as low as 6.784 cents. However, the revenue is in several cases correspondingly low, and there is a need for a general increase in the receipts. Although in the case of two tubes the ratio of working expenses to receipts is only 47.9 and 49.6 per cent, respectively, on another tube it is actually 71 per cent. On the London County Council tramways the corresponding ratio is 65 per cent, which is not by any means perfectly satisfactory. When the very much greater capital expenditure per mile of route of the tube railways is considered, it is evident that as the working expenses are not likely to decrease, there must be a considerably increased good return on the capital invested. The extent to which the majority of the lines are handicapped by their excessive capital expenditure may be gathered from the fact that this expenditure is in round figures $3,000,000 per mile of route, and the number of car-miles run per year per mile of route is about 6000. Consequently, a sum of about 5 cents per car-mile must be earned to pay 1 per cent on the capital, apart from working expenses. Two of the tubes are in a somewhat better condition, since the corresponding costs are 2.34 and 2.68 cents, respectively. As to the cost of maintenance, the newest tube has a value per car-mile for maintenance of track of nearly two and one-half times as great as in the case of the oldest tube. The larger cars in use may have somewhat to do with it.—Lond. *Electrician,* Nov. 8.

Traffic Estimates.—W. MATTERSDORFF.—A statistical investigation of the different factors on which traffic on electric street railways depends, so as to permit an estimate of the traffic to be expected on a new street railway. The number of passengers carried per year increases with the square of the number of inhabitants of a city up to 500,000 inhabitants; after that it increases directly with the number of inhabitants. The number averages 67,000,000 trips per year for 500,000 inhabitants. A similar relation exists between car-miles and the number of inhabitants. The author introduces the term "passenger traffic density," which is defined as the total number of passengers per year multiplied by the length of the road and divided by the number of car-miles per year.—*Elek. Zeit.,* Oct. 24.

Electric Gasoline Automobiles.—J. BETHENOD.—Gasoline automobiles may be equipped with a dynamo and a storage battery so that the dynamo may act either as generator or to store up the excess energy of the gasoline engine in the battery or as motor, being driven by the battery to aid the gasoline engine when more power is required. The author gives a graphical representation of the properties of such a system.—*L'Eclairage Electrique,* Oct. 5.

Fog Signalling Apparatus.—A description of a new form of auxiliary signalling apparatus in which the signals are repeated in the cab of the locomotive, both at the home and distant signals, which is in experimental use on the Southeastern & Chatham Railway. Telephonic communication between the signal-box and the driver's cab is also provided for.—Lond. *Elec. Eng'ing,* Nov. 7.

Electrophysics and Magnetism.

Ratio of the Electromagnetic to the Electrostatic Unit of Electricity.—E. B. ROSA AND N. E. DORSEY.—The conclusion of their long account of an experimental redetermination of the ratio of the electromagnetic to the electrostatic unit of electricity. In the present instalment the determination of capacities in electromagnetic measure is described and the ratio of the two units is determined from the electromagnetic and the electrostatic measurements. Their final result is 2.9963×10^{10} $\left[\frac{\text{cm intern ohm}}{\text{sec}}\right]^{\frac{1}{2}}$ in air at 20 deg. C., or referred to vacuo 2.9971×10^{10}, while the results of former experimenters are as follows:

Himstedt	3.0057×10^{10}
Rosa	3.0000×10^{10}
Thomson and Searle	2.9960×10^{10}
H. Abraham	2.9913×10^{10}
Pollat	3.0092×10^{10}
Hurmuzescu	3.0010×10^{10}
Perot and Fabry	2.9978×10^{10}
Mean	3.0001×10^{10}

It will be seen that the value obtained by the present experimenters is a little more than 1 in 1000 less than the mean value of the former determinations. All the above results refer to air. On the other hand, the various determinations of the velocity of light in vacuo have given the value 2.9986×10^{10} cm per second with an accuracy of 1 in 10,000. This differs from the authors' value for the ratio of the electric units by 5 parts in 10,000, with a possible uncertainty of 2 parts in 10,000. The same issue contains a critical comparison, by the same authors, of the various methods of determining the ratio of the electromagnetic to electrostatic unit of electricity.—*Bulletin, Bureau of Standards,* Vol. III, No. 4, October.

Thermoelectricity of Nickel.—H. PECHEUX.—The thermoelectric properties of nickel are peculiarly subject to masking by metallic impurities. The author has studied the effect of these impurities, more especially in connection with his copper-nickel pyrometer. Among the specimens of commercial nickel investigated, the most fusible one contained 0.8 per cent of copper, 0.2 per cent of carbon and silicon, and traces of iron and cobalt. The least fusible contained 1.5 per cent of iron, 0.5 per cent of cobalt, 0.1 per cent of carbon and silicon, and traces of copper. The fusible specimen was brittle, and both were hard. The curves of e. m. f. of both specimens intersect at 200 deg. Annealing for 20 hours at 640 deg. has the effect of rendering the e. m. f.'s constant, so that a useful and constant thermoelectric pyrometer may be made with either specimen, but their readings may show differences of some 8 per cent according to composition. An even more marked effect is shown when both cobalt and copper are present as impurities. This is accompanied by a marked change in the resistivity.—From *Comptes Rendus,* Oct. 7; abstracted in Lond. *Elec. Eng'ing,* Oct. 31.

Thermoelectricity.—W. D. HENDERSON.—A second paper on the thermoelectric behavior of metals in solutions of their salts. In the present paper cadmium amalgam in a solution of cadmium sulphate is investigated. The conditions were found to be the opposite of those which obtain in the case of silver, formerly investigated. He shows that the thermo-electromotive force observed cannot be accounted for on the assumption of an increase of osmotic pressure.—*Physical Review,* November.

Silicon.—F. G. WICK.—The first of a series of papers on electric properties of metallic silicon. In the present installment the thermoelectric behavior of silicon is dealt with. It is thermoelectrically negative with respect to copper; the direction of the current is from silicon to copper through the hot junction. The thermal e. m. f. generated by a lead-silicon junction is very large.—*Physical Review,* November.

Effect of Vibration upon Magnetization.—J. RUSSELL.—An account of an experimental investigation of the superposition of mechanical vibrations and of high-frequency electric oscillations upon magnetization, and conversely in iron and steel and nickel. Two methods were used, in the first of which mechanical vibrations are superposed upon a constant field. The effects of the mechanical vibrations or of the electric oscillations, superposed at all stages of the normal loop, are to lessen those differences of magnetization to which hysteresis without vibrations has already given rise. In the second method, a change of field is superposed upon mechanical vibrations permanently acting. In this case the results cannot be concisely stated in terms of hysteresis. They are, however, subject to the condition that

vibrations or oscillations increase the differential permeability in low fields, and decrease it in high fields. In sufficiently high fields vibrations or oscillations must delay demagnetization.—*Phil. Magazine,* October.

Current and Friction.—P. R. HEYL.—A further paper in his series on some physical properties of current-bearing matter. In the present paper the author discusses the effect of a current upon friction between a solid and a liquid, the liquid being mercury and the solid either carbon or iron. In the case of carbon a change of friction is observed as result of the current, but this can be accounted for as an effect of the heat at the liquid-solid contact surface. This is confirmed by the absence of any effect of current upon friction in the case of iron, where the heating effect is negligible.—*Physical Review,* November.

Radiations.—R. T. BEATTY, J. A. CROWTHER, J. KUNZ, R. D. KLEEMAN.—Four papers on various kinds of radiations. Beatty gives an account of an experimental investigation of secondary Roentgen radiation in air. Crowther deals with the secondary Roentgen radiation from gases and vapors. Kunz discusses an abrupt limit of distance in the power of the positive rays to produce prosphorescence. Kleeman deals with the secondary cathode rays emitted by substances when exposed to the gamma rays.—*Phil. Magazine,* November.

Electrochemistry and Batteries.

Fixation of Atmospheric Nitrogen.—A summary of a large number of recent publications on this subject. Some notes are given on recent developments in processes using electric discharges through air. Another method of fixation of atmospheric nitrogen is the production of calcium cyanamide. To produce this Frank and Caro simply treat commercially calcium carbide with nitrogen. Others have suggested some additions to increase the yield. Calcium chloride and calcium fluoride appear to be the best additions. The reasons of their action are discussed. A simple method of isolating argon from air is to heat calcium carbide containing 10 per cent of calcium fluoride in a retort to 800 deg. C., and to introduce pure dried atmospheric air. The oxygen and the nitrogen are absorbed by the carbide and there remains nothing but the argon and the other noble gases.—*Electrochem. and Met. Ind.,* November.

Nitric Acid from Air.—I. MOSCICKI.—A long illustrated description of his experiments on the production of nitric acid by electric discharges through air. These experiments have been made during the last seven years in Freiburg, in Switzerland, on a somewhat large experimental scale. The author first endeavored to use high-frequency high-tension discharges with the aid of special arrangements of condensers and inductance coils. This system was a failure, however, on account of the high cost of the electrical apparatus required. He then took up a new system in which an electric arc is used, which is magnetically deviated. The arc plays between two concentric copper rings which act as electrodes. A magnetic field is provided perpendicular to the plane of the two rings, and the arc is thereby caused to revolve around in the annular space between the two rings so as to give the impression of a luminous ring. The yield is as good as with the Birkeland-Eyde process, and the author hopes to be able to improve it.—*Elek. Zeit.,* Oct. 17, 24, 31.

Electric Steel.—FITZGERALD AND BENNIE.—At the present time the direct production of steel from ores is impossible owing to certain technical difficulties, but by applying the Lash process for the production of steel in the open-hearth furnace with suitable modifications for the electric furnace, it is believed that the problem can be solved. A comparison of the cost of the Lash process in the open-hearth furnace and in the electric furnace shows that in the latter very much less pig iron is required and that the corresponding saving in the cost of raw materials is apparently sufficient to pay for the treatment in the electric furnace.—*Electrochem. and Met. Ind.,* November.

Electric Furnace.—A note on a proposition by Saklatwalla to employ refractory oxides (such as are used as filaments in the Nernst lamp) for resistors in electric furnaces. Since they become conductors only at high temperatures, they must be preheated. For this reason a furnace is suggested in which the temperature is raised step by step. The lowest range of temperature is obtained by means of nickel as resistor material, the next range by tin oxide, which becomes a fair conductor above 600 deg. C., and the highest range of temperature by means of magnesia, which becomes a good conductor above 1500 deg. C.—*Electrochem. and Met. Ind.,* November.

Copper Refining.—J. W. RICHARDS.—A full discussion of electrolytic refining of impure copper, which subject lends itself very well to calculation. The author discusses the energy absorbed by the electrolyte and the energy lost in contacts and in conductors.—*Electrochem. and Met. Ind.,* November.

Bunsen Society.—An account of the annual meeting of the German Bunsen Society, in Hamburg, with abstracts of the papers presented. Among them was a symposium of numerous papers on radioactivity and disintegration of atoms. A paper by Foerster deals with the influence of temperature on metal deposition.—*Electrochem. and Met. Ind.,* November.

Units, Measurements and Instruments.

Cosine Flicker Photometer.—J. S. DOW.—The illumination of the white surface employed in any photometer is inversely proportional to the square of the distance of the source of light from the illuminated surface and directly proportional to the cosine of the angle between the rays of light striking the surface and the normal to the surface. Hence, when measuring the intensity of a source of light, we may either vary the distance, in which case the inverse square law is used, or we may vary the angle of the rays with the normal to the surface, in which case the cosine law is utilized. The latter arrangement has the advantage that a photometer may be kept stationary and the illumination of the photometrical surfaces adjusted in the photometer itself. The two sides of the rectangular Ritchie wedge, *W,* in Fig. 5, are illuminated by the two sources *A, B.*

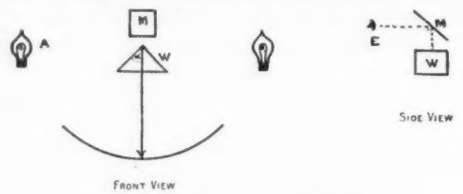


FIG. 5.—FLICKER PHOTOMETER.

Above the wedge a 45 deg. mirror, *M,* is placed so that the observer's eye at *E* sees an image of the illuminated surfaces reflected in this mirror. The wedge is arranged to rotate about the line of intersection of the photometrical surfaces as a horizontal axis. To the observer, therefore, this line appears stationary as the wedge is rotated. Suppose now that the two sources *A, B,* are equidistant from the wedge. Then, if the intensities of the two sources are the same, photometrical balance is obtained when the wedge is placed symmetrically about a vertical axis, as shown. If, however, *A* is the brighter of the two sources, the wedge must be rotated in a clockwise direction, so that the rays from *A* strike the surface presented towards *A* more obliquely than before, while, conversely, the rays from *B* strike the surface presented less obliquely. Let 45 deg. be the inclination of either surface to the vertical, when the wedge is in its symmetrical position. Then by turning the wedge until equal brightness of the two illuminating surfaces is obtained, the angle of rotation indicates the ratio of the intensities of the two sources of light. This ratio equals the ratio of cosine $(45-a)$ to cosine $(45+a)$ if a is the angle by which the wedge was turned. The instrument may be used either on the equality of brightness or on the flicker principle. As shown in Fig. 6, the image of the wedge, as formed by the mirror, *M,* is outside the focal length of the convex lens, L_1, and this, together with the lens, L_2, forms a real image of the illuminated surfaces in the plane of the aperture at *A.* The eye of the observer applied to the third lens, L_3, sees a magnified image of the aperture and the illuminated surfaces—both simultaneously in focus. If, now, an observer is comparing, say, a red source

with a green one, the field of view appears to him as shown in Fig. 7, *a* when the lens L_1 is stationary. He then adopts as photometric balance the position of the photometer-wedge in which the red and green fields appear equally bright. The element of flicker may, however, be introduced by modification of the method due to Rood. The lens L_1 is mounted on springs

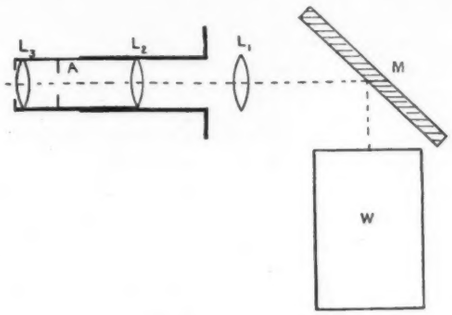


FIG. 6.—FLICKER PHOTOMETER.

and attached to a cord passing over a pin mounted eccentrically on the pulley of a small electric motor. When the motor is caused to rotate the lens oscillates to and fro, and the boundary between the photometrical surfaces appears to oscillate with it. A band of flicker is thus produced, and the field of view assumes the appearance shown at *b* in Fig. 7. The observer may then judge the position of photometric balance by observing the cessation of flicker in the band. Or he may drive the motor so fast that all flicker disappears and the intermediate band merely assumes a color intermediate between that present in the two adjacent portions of the field of view. He may then use this intermediate color to assist him in his decision as to the exact point when all three sections of the field of view appear equally bright. When the instrument is used on the equality of brightness or on the flicker principle, the agreement between the results of the two methods is very close unless there is a great difference of color in the two sources of light.

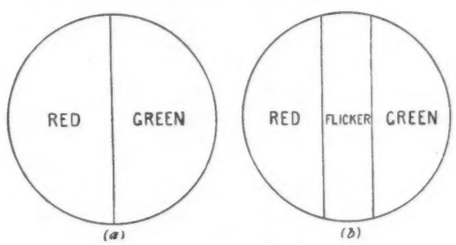


FIG. 7.—FLICKER PHOTOMETER.

For very widely different colors, there is some discrepancy between the results of the two methods, but the flicker method gives rise to the most consistent results.—*Phil. Magazine,* November.

Potentiometer Installation.—W. P. WHITE.—A discussion of a potentiometer installation especially for high-temperature and thermoelectric work. For the most accurate pyrometry, with temperatures up to 1600 deg., the direct-reading pyrometer is not sufficiently sensitive, the resistance thermometer has not sufficient range and is, moreover, too bulky for the best melting-point work. A thermoelement with a potentiometer is the most satisfactory measuring apparatus. The most characteristic requirement in melting-point and calorimetric work at high temperatures is rapidity. This is secured (a) by proper selection and arrangement of the galvanometer, periods of five seconds being almost necessary and being readily obtained; (b) by the use of switches to exchange thermoelements, adjust zero, etc., (c) by relying upon the galvanometer for as much of the reading as possible, so as to minimize potentiometer manipulation. For this, constant galvanometer sensibility, and, therefore, constant resistance in the branch circuit of the potentiometer is needed. An adjusting rheostat in the circuit secures this result fairly well for ordinary potentiometers, whose branch circuit resistance is variable. External leakage can be absolutely prevented and internal leakage greatly diminished by equipotential shields, which interpose a continuous metallic surface between the circuit and the source of disturbance. Internal leakage also decreases with the resistance of the potentiometer. The constancy of the potentiometer storage cell is increased by a wrapping which protects it from temperature changes. With galvanometers of familiar commercial types, a sufficiently short period, five seconds, with satisfactory critical resistance and sensibility, can be obtained with a high-resistance potentiometer. Either an especially good galvanometer or potentiometer of low resistance makes possible a somewhat better adjustment. A slide-wire potentiometer is very undesirable in rapid work, and especially in melting-point and calorimetric determinations. By confining the range of the potentiometer to that actually needed in thermoelectric work, an instrument of almost ideal convenience and usefulness can be obtained at relatively low cost. It has constant galvanometer sensibility, low resistance and ease of manipulation, and can be used on two circuits alternately without resetting.—*Physical Review,* November.

Discharge of Electricity.—J. ZELENY.—An account of an experimental investigation of the discharge of electricity from pointed conductors different in size. The author finds it possible to select conditions for the discharge from pointed conductors so that the numerical results obtained may readily be reproduced with new points and apparatus. This is made possible for the most part by using terminals of such a simple and definite shape that they may easily be duplicated with sufficient accuracy. For this purpose it has been found that terminals made of cylindrical wires of a sufficient length, with their ends either rounded or plain, are very convenient and give regular results depending only upon the diameters of the wires. Curves are given from which it is possible to find the current that will be produced in dry air, under the normal conditions given, from a point of any size up to 2 mm. in diameter, for any given potential. Corrections are also given by means of which it is possible to extend the results to any temperature usually found in the room and to a considerable range of pressures near that of the atmosphere. Voltages may be determined with fair accuracy by measuring the current in a point of known size and using a potential-current curve drawn for the particular point by the aid of the results here given. The potential required to start a discharge and the diameter of the point are so related, at least for a limited range, that the minimum potentials minus a constant are proportional to the square roots of the diameters of the points. This relation holds especially well for points with plane end. The relation between the current I at a point and its potential V may be represented quite well for the positive discharge from any point by Warburg's formula, $I = aV\ (V - M)$, where M is the minimum voltage required to start the current and a is a constant. This formula is extended to include at once terminals of all sizes, by changing the constant "a" to $a\ (1 + bd)$, where d is the diameter of the terminal and a and b are new constants.—*Physical Review,* November.

Telegraphy, Telephony and Signals.

Electrical Transmission of Pictures.—A. KORN.—An article on his apparatus for the electrical transmission of photographs. In its elements the apparatus consists of a pair of glass cylinders, one at each end of the line, having a helical motion of such a kind that every element of the surface of each is brought in succession under a beam of light from a Nernst lamp placed over it, and the movements of the two cylinders are exactly synchronized. The cylinder at the sending end carries on a transparent film the picture to be transmitted. That at the receiving end carries a sensitive film, and the light from its lamp is intercepted by a screen carried on the wire of a string galvanometer placed in the line circuit, so that the amount of light falling on this sensitive receiving film varies with the current in the line. The beam of light at the transmitting end, after passing through the picture film, falls on a selenium cell

inside the cylinder, so that the amount of light falling on the cell, and, consequently, the resistance of the cell, varies with the density of the particular element of the film found under the lamp at that moment. The selenium cell and a storage battery are placed in the line circuit, and the current in the line varies continuously with the density of elements of the picture as they are brought in succession under the lamp by the rotation of the cylinder. This line current, by displacing more or less the screen of the string galvanometer at the receiving end, regulates the amount of light falling on the element of the sensitive film, and thereby the density of the photographic negative is produced. The two principal problems presented are (1) the synchronizing of the cylinders, and (2) the regulation of the action of the selenium cells in such a way that the density of the negative produced shall correspond to that of the film at the transmitting end, element to element. As to the method of obtaining synchronism, the receiving cylinder runs a little faster than the transmitter, is checked by a pawl near the end of each revolution, and starts the next revolution in exact synchronism with the transmitter; that part of the receiving cylinder which comes under the lamp during the regulating period is not used for the picture. The regulation of the selenium cell is a much more complicated matter, since its resistance at any instant is not simply a function of its illumination at each instant, but depends upon its previous history; and the effect of any change of illumination is not instantaneous, but requires time to produce its effect. In Fig. 8 a Wheatstone's quadrilateral is constructed of two similar selenium cells, *Se*, 1 and *Se*, 2, and a continuous sliding resistance R_1R_2. A battery of accumulators is connected as shown. The bridge *ABCD* includes a string galvanometer, *B*, whose wire carries a screen, the line wires, the distant receiving apparatus *C*, and

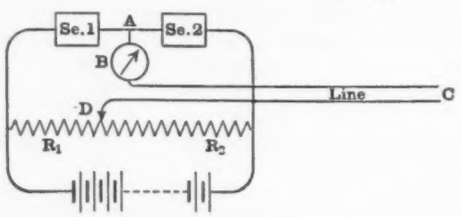


FIG. 8.—TRANSMISSION OF PICTURES BY ELECTRICITY.

the sliding contact *D*. *Se*, 1 is the cell of the transmitting instrument, illuminated by the light passing through an element of the picture. *Se*, 2 is an independent, but similar cell, illuminated by light from another lamp, whose light, however, is intercepted by the screen carried on the wire of the string galvanometer *C*, so that the illumination of *Se*, 2 is proportional to the displacement of *B*; that is, to the line current. The position of *D* and the resistance of the line are now adjusted, so that the illumination of *Se*, 1, *Se*, 2 are equal when the element of the picture under transmission is one having a mean density. The illumination of the sensitive receiving film is then adjusted to give a corresponding density to the negative—that is, when an element of the picture of about the mean density is being properly transmitted, the illumination of the two equal cells, *Se*, 1 and *Se*, 2, are equal. Now, as the cylinder of the transmitting instrument revolves and different elements of the picture come into operation, the light falling upon *Se*, 1 varies continually, up and down, about the mean value for which the above adjustment was supposed to be made; and the current in the bridge and line, and the illumination of *Se*, 2 will also vary up and down about their mean values. Calling the difference, excess or defect, of the bridge current from its mean value *a*, and the conductivities of the cells c_1, c_2, we may assume as a first approximation that *a* is proportional to $c_1 - c_2$. The author finds that the conductivity of a cell may be represented by a formula, $C + ki + KI$, where *i* is the difference between the instantaneous value of the illumination, and its mean value, *I*, a function of the previous illumination, *C*, *k*, *K* are constants. As *Se*, 1 and *Se*, 2 are similar, the constants *C*, *k*, *K* have the same values in each. The illumination of both *Se*, 1 and *Se*, 2 oscillates about a mean value, the same for the two, and it appears that under these circumstances the values of *I* may be treated as being equal. Writing, then,

$$c_1 = C + ki + KI$$
$$c_2 = C + ki^2 + KI$$

and remembering that i^2 is proportional to *a* and to $c_1 - c_2$ by the construction of the apparatus, we find that *a* is proportional to *i*. That is, the excess of the line current over its mean value is proportional to the excess of the illumination of *Se*, 1 over its mean value; and it is clearly only a matter of adjustment to make the total line current proportional to the total instantaneous value of the illumination of *Se*, 1. In this way the use of two equal cells permits the elimination of the effects of the inertia of either. A detailed diagram of the whole apparatus is given.—Lond. *Electrician*, Nov. 8.

Magnetic Oscillators.—J. A. Fleming.—An abstract of a (British) Physical Society paper on magnetic oscillators as radiators in wireless telegraphy. An open or Hertzian oscillator is called an "electric oscillator," because the effects produced in space are due in part to the potential of the free charges at the ends. A closed-circuit oscillator is called a "magnetic oscillator" because the effects it produces are wholly due to current. Hertz has given a formula for the open electric oscillator, and the present author shows that a similar formula holds good for the closed-circuit magnetic oscillator. The radiation from the open oscillator varies as the square of the frequency, and that from the closed one as the fourth power. The paper describes experiments made with flat square coils of various sizes used as magnetic oscillators in the quadrangle of University College, London. In one circuit undamped oscillations were set up by means of a Poulsen arc, and the induced oscillations created in the other circuit at a distance were detected and measured by means of the author's oscillation-valve or glow-lamp detector. The distance separating the two circuits was varied from about 50 ft. to 250 ft. Curves were obtained showing how the secondary current varied with the distance of the circuits apart and with their relative position. It was shown that the inductive effect was greatest when the flat coils were in a horizontal position, and at a certain distance above the earth. The law of variation with distance proved to be between the inverse cube and the inverse square of the distance. It was then shown that increase in size of the coils had a very marked action in increasing the inductive effect, and also that for equal power the use of the spark method creating intermittent oscillations in the primary gave better effects than the use of the arc or undamped oscillations. It was also shown that for the coils used, the true radiation of energy was very small, and therefore that the distance effects obtained were due almost entirely to magnetic or Faradaic induction. Suggestions were then made for increasing the efficacy of the ordinary inductive type of wireless telegraphy by the use of high-frequency oscillations in the primary circuit, and a suitable detector, such as the author's oscillation valve, combined with a telephone as a receiver in the secondary circuit. Such a method would have a far greater reach than ordinary low-frequency alternating-current inductive telegraphy and would not be open to the objection of disturbing commercial telephonic circuits.—Lond. *Electrician*, Nov. 8.

Milan Exposition.—An illustrated account of various exhibits relating to telegraphy and telephony at the recent international exhibition at Milan. Among those described is a modification by Bogni of the Morse apparatus and the Morse alphabet, a modification by Dubreuil of the Baudot apparatus for multiple telegraphy, and various telephonic apparatus.—*Elek. Zeit.*, Nov. 7.

High-Frequency Arc.—J. Sahulka.—An illustrated article in which the author describes the production of a high-frequency arc between carbon electrodes in the oscillation circuit of a Duddell-Poulsen arc. In his experiments the frequency was independent of the length of the arc and was about 25,000. The potential difference at the arc was only 14 volts for short arc lengths and 40 volts for a length of 9.5 millimeters. From the very low value of the potential difference at which the arc can be formed it must be concluded that the half waves of the

high-frequency current have a very sharply pointed form.—*Elek. Zeit.*, Oct. 31.

Combination Transformer.—E. MUELLENDORFF.—Describes a transformer (Mischtransformator) with several primary windings which carry sinusoidal currents of any amplitude, phase and frequency, superposed upon each other in the secondary winding. Such transformers are used, for instance, for the transmission of music. The author gives the fundamental equations of such transformers.—*Elek. Zeit.*, Oct. 17.

BOOK REVIEW.

ARMATURE CONSTRUCTION. By H. M. Hobart and A. G. Ellis. New York: Macmillan Company. 348 pages, 418 illustrations. Price, $4.50.

This book contains 13 chapters dealing with the mechanical features of stationary and revolving armature cores and coils, and the testing of completed equipments. Very little of so-called "theory" is given, but the book will prove of value to the theorist. It records modern practice in assembling laminations, insulating coils, building commutators and connecting up the windings. Approximately one-third of the volume is devoted to the various circuit schemes of single-phase, polyphase and direct-current armature windings. Most of the diagrams are printed in colors, a method that assists greatly in tracing the circuits. A brief discussion is given of the insulating of armature conductors. The devices employed in shaping the coils of direct-current and alternating-current armatures are treated at great length, emphasis being placed on the methods developed by the most successful manufacturing companies.

The book should prove of considerable assistance to designers and builders of electrical machinery.

Jamestown Exposition Awards.

Following is a list of awards of medals to exhibitors at the Jamestown Exposition:

GOLD MEDALS.

Allis-Chalmers Company—Electric generators and motors.

Aluminum Company of America—Manufactured products of bauxite and alumina.

Baker & Company—Platinum ore and products.

Babcock & Wilcox Company—Water-tube boiler, semi-marine type.

Carborundum Company—Metallic silicon.

Chas. A. Schieren & Company—"Duxbak" waterproof and "Duxbak" steamproof leather belting.

Carborundum Company—Carborundum and manufactured products.

De Laval Steam Turbine Company—Steam turbines.

General Electric Company—Motors.

General Electric Company—Arc and incandescent lamps and electric cooking appliances.

Goulds Manufacturing Company—Power pumps.

Heine Boiler Company—Water-tube boilers.

International Correspondence Schools—System of technical instruction by correspondence.

Kny Scheerer Company—Surgical instruments, hospital supplies and apparatus.

National Meter Company—Nash gas engines and water meters.

Newport News Shipbuilding & Dry Dock Company—Model of ship fully equipped.

Organ Power Company—The Spencer steel "orgoblo."

Otto Gas Engine Works—Gasoline engines.

R. D. Wood & Company—Gas producers.

Robins Belt Conveyor Company—Belt conveyor.

Shelby Steel Tube Company—Seamless steel tubing.

Westinghouse Machine Company—Gas-producer engines and stoker.

SILVER MEDALS.

Atlas Engine Works—Gasoline engines.

Automatic Refrigerating Company—Automatic system of refrigeration and thermostat.

Benjamin Electric Manufacturing Company—Wireless clusters for incandescent lamps.

Contractors' Supply & Equipment Company—"Little Shaver" floor scraper.

F. W. Devoe & C. T. Raynolds Company—School water-color paints.

Jordan Bros.—Jordan commutating truing device.

Middletown Machine Company—Gasoline engines.

Morgan & Wright—Bicycle tires, molded rubber goods and sundries.

The Bristol Company—Bristol's recording voltmeters.

Under Feed Stoker Company of America—Under-feed stoker.

Wagner Electric Manufacturing Company—Single-phase, alternating-current motor and motor-generator set.

BRONZE MEDALS.

Electric Blower Company—Electric forge blower.

General Electric Company—Special motor used with rock drill.

Prometheus Electric Company—"Prometheus" electric air heaters.

Portable and Switchboard Instruments.

The Dongan Electrical Instrument Company of Albany, N. Y., has recently placed on the market a new line of portable and switchboard instruments for alternating current and direct current. Up to the present time the instruments turned out by this company have been dampened by the use of a light aluminum fan attached to the needle. By this method the needle is brought to rest in about 3 seconds after current is thrown on the meter, needle starting from zero. By the construction used in the new type of instrument, the needle is brought to rest instantly.

The instrument is finished with black enameled body with nickel and black covers; raised parts nickel, background black. The scales are large, nearly evenly divided, very clear and distinct. The instrument is furnished in two sizes, the standard being 8⅝ ins. and the small size 7 ins. in diameter. Transformers can be furnished with all alternating-current instruments if desired.

The portable instruments are very accurate and reliable, finished in mahogany and bronze; absolutely dead beat and ironclad, weighing about 2 lbs., measuring 6¼ ins. by 6 ins. at base. While these instruments are of the alternating-current type, they may be used on direct-current circuit with great accuracy by the use of a small constant.

Handy Tools for Wiremen.

The line of standard tools made by the North Brothers Manufacturing Company, of Philadelphia, Pa., and termed "Yankee Tools," embrace ratchet screw-drivers, spiral screw-drivers and hand or push drills. The tools are especially useful for wiremen and other mechanics who have to drive screws, drill holes, etc., enabling them to do such work quickly and comfortably. The spiral ratchet screw-driver operates to insert or to withdraw screws by pushing the handle. The direction of rotation of the blade is easily changed by shifting a small slide. The tool can also be used to ratchet screws in at the finish or to ratchet them out at the start when they may then be pushed either in or out. Attachments are also furnished for drilling holes and for countersinking them. Thus a single tool does a variety of work and does away with numerous tools. For driving smaller screws, such as those used in fastening push buttons, a smaller tool, because of its smaller size and weight, is more desirable and also because this smaller tool has straight bits which will pass through holes.

The hand or push drills required for screws or to make holes for wires through woodwork are made in several styles. Where, as is often the case, holes are required to be drilled

through metal, as well as wood, the drill shown in Fig. 2 is most effective. In the ratchet screw-drivers the friction of the mechanism is said to be hardly felt. On the blade is a knurled washer, by means of which the blade may be turned with a finger and thumb. This permits the hand holding the handle to press steadily against the screw and prevent it from wobbling, while the thumb and finger can turn or ratchet the blade

FIGS. 1, 2, 3 AND 4.—HANDY TOOLS FOR WIREMEN.

until the screw is well started, when it can then be driven home by the hand on the handle. A slide is provided for changing the direction of rotation as in the case of the spiral ratchet screw-driver. The pocket magazine screw-driver shown in Fig. 4 is equipped with four blades of different sizes carried in the magazine handle. This is a handy tool for adjusting screws in telephones and electrical apparatus. When closed it measures 3 ins. long by 5/8 in. in diameter and weighs two ounces.

Wall Case for Metal Armored Cables.

The wall case illustrated herewith has been produced to meet the increasing demand for a case for use with metal flexible

FIG. 1.—WALL CASE FOR METAL-ARMORED CABLE.

ducts and flexible metal-covered wires. As indicated in Fig. 1, adjustable lugs are provided for adapting the case to old or new equipments, and the "knock-outs" are placed in the corners. Referring now to Fig. 2, it will be noted that, in placing the wall case, the conduit is drawn through in the position shown by *F*. As the case is pushed into the opening through the wall, the conduit itself describes an arc through the corner of the wall case, taking the position *G*, and finally the position *D*. It is then held in place by clamp *E*, which is fastened with one screw.

The wall case can be inserted in an opening 2 in. x 3 in.

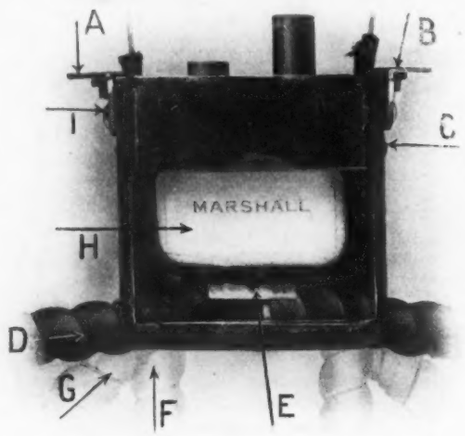
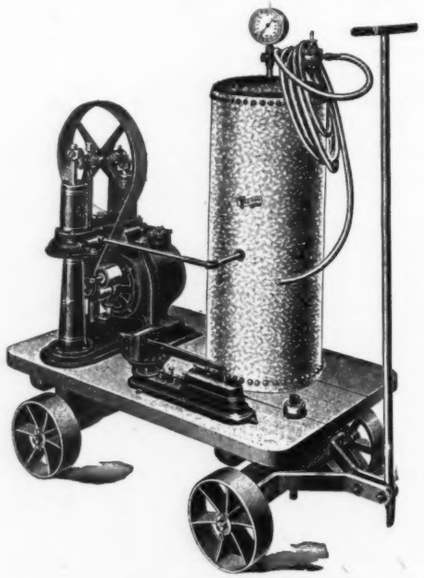


FIG. 2.—PART-SECTIONAL VIEW OF WALL CASE.

through a wood panel, and the box can be quickly and suitably installed in a 4-in. partition. These boxes are being put on the market by the Marshall Electric Manufacturing Company, 301 Congress Street, Boston, Mass.

Portable Air Compressor.

The Victor Electric Company, of Chicago, Ill., has perfected a portable air compressor outfit shown herewith. The equipment is especially useful and effective in cleaning dust and dirt from the back of switchboards and out of the windings of motors and generators. The air pump is driven by a small motor as shown, the electrical energy being supplied through a flexible cord from the nearest socket. The pump is automatic in its operation, the electric circuit to the motor being controlled by a switch which opens or closes the circuit at predetermined



VICTOR PORTABLE AIR COMPRESSOR.

air pressures. The air tank is fitted with a pressure gage and a rubber hose of ample length for all ordinary purposes. The complete outfit is mounted on a substantially built truck by means of which it may be readily moved from place to place.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Actual business throughout the country, both wholesale and retail, showed some improvement, and a more hopeful sentiment was reported. In wholesale trade circles there was an evident indisposition to do business for future periods. Retail trade felt the effect of the smaller movement of cereals from the farms, and although producers are reported more familiar with checks tendered in payment, lower prices now offered are a drawback to sales. In the industries the features are working out more fully on the slowing-down tendency noted recently. The iron and steel industry, with its kindred lines, such as coke and coal, shows quickest results. Lumber is quieter and there is talk of curtailing production on other lines, thus avoiding unnecessary overstocking. Collections are somewhat slower and business failures were slightly more numerous, but not so important as those of last week and the preceding weeks. Railway earnings for October show a gain of less than half that of September, and those recorded for the second week of November point to an actual decrease. The market for pig iron was almost lifeless. Production is being curtailed, and it is estimated that the U. S. Steel Corporation has something over 40 per cent of its furnaces out of blast, to which must be added the inactive plants of independent interests. At some places wages have been reduced 10 per cent. Business in steel rails was very light, and some mills are closing down. The demand for structural material has improved. The producers of steel have virtually agreed not to cut prices, believing that as finished products have been maintained at a steady level even during times of prosperity, a reduction is not warranted. Copper was dull and weaker, and prices declined about ⅜c., but rallied ⅛c. later in the week, although there was not much new business reported. The metal continues to go abroad in large quantities, principally because it can more readily be financed there than here. Foreign trade in October was larger than in September, both in imports and exports, the exports aggregating $180,559,464, while imports amounted to $111,811,982—gains of respectively 33 and 11 per cent over September. *Bradstreet's* reports 265 business failures during the week ended Nov. 21 as compared with 259 in the previous week, and 212 in the corresponding week of last year.

THE COPPER SITUATION.—The National Conduit & Cable Company's "Copper Gossip," of Nov. 20, says: "In the midst of the recent unfortunate financial situation there came the flurry in the price of copper, when during the three worst days of our money troubles the metal advanced 25 per cent, a most unprecendented advance, length of time considered, and at that without any apparent reason. Our only concern should be to know what has become of the immense volume of copper said to have been sold. If it shall develop that it has not been all sold, but shipped or "sold" abroad for purposes of finance, these bills must some day become due. If, on the other hand, the material shall have gone into the hands of speculators, at some future day what if there should be 100 sellers where a month ago there were but 10. Certain it is that with lack of money new enterprises have not taken the copper, and without new enterprises no such amount of metal could be consumed as is claimed to have been sold. No new undertaking should commit itself for material until it is financed to the limit, since for a long time to come investors will look with suspicion on anything not tried and known. We may see a great surplus of money during the first months of 1908, but bankers will necessarily guard it with jealous care lest we precipitate a state of affairs like the present. Everything considered, and the poor outlook for an early improvement in business, we ask should present prices hold? Other phases of the situation might be considered, such as the reduction in output to prevent further accumulation, and the postponement of new enterprise until financial accommodations are obtainable, but in the present temper of business conditions it will take a long time to bring about a restoration of confidence. As things are now we are not surprised that copper has declined from 15. Bottomed on sound conditions these prices would not be considered high, but until the market gets on a solid foundation we believe the safe course for the consumer is the conservative one."

LARGE ALLIS-CHALMERS ORDERS.—In view of the generally unsettled conditions existing in business circles throughout the country, during the past few weeks of financial stringency, a statement of shipments made from the works of the largest engineering and machinery building company of the United States, for the six months preceding Nov. 1, carries more than ordinary interest and significance. During this period Allis-Chalmers Company sent out machinery on orders as follows: May, 23,772,242 lbs.; June, 22,139,757 lbs.; July, 24,225,760 lbs.; August, 26,006,434 lbs.; September, 26,268,764 lbs.; October, 27,821,682 lbs. From these figures it will be seen that, while there has recently been some cessation in "new business," viz., contracts for future fulfillment, the receipt and installation of machinery by industrial, lighting and power companies indicates continued progress. It required nearly five thousand cars to transport the 150,234,639 lbs. of machinery, mentioned above, from the works of Allis-Chalmers Company to the various places where it was to be operated, and, of course, even more than this number of cars was used for bringing in the raw materials, fuel, lumber for patterns, etc., which are necessary in the manufacturing process.

GROWTH AT MONTEREY, CAL.—The new Station "A" of the Monterey County Gas & Electric Company is fast approaching completion at Monterey, and it is expected that it will be delivering electrical energy before the Christmas holidays. While not remarkable for its size, the new plant is noteworthy in the thoroughly modern character of its design. Alternating current at 2300 volts, three-phase, is generated by two 500-kw Curtis steam turbines direct connected to General Electric generators. One 300-kw and one 125-kw motor-generator sets utilize a part of this power for the street railway system and a 2300-volt feeder and network supplies light and power to the cities of Monterey and Pacific Grove and their environs. Steam is furnished by Babcock & Wilcox water-tube boilers with oil furnaces. The new station adjoins the old power house, which will be dismantled as soon as the change over can be made. Wm. H. P. Hill is general manager of the company and F. J. Southerland, general superintendent.

OPPORTUNITY IN ASIA.—One of the American consular officers in Asia reports the granting of a concession for the construction of an electric railway, for the lighting of streets, and the supplying of electric power at the place in question. He furnishes the names of the officials of the new company, and states that it would be a profitable investment for the manufacturers of electrical goods to maintain an active agent there to take advantage of trade opportunities as they present themselves. Details can be had from the Bureau of Manufactures of the Department of Commerce and Labor. An American consul in Asia Minor furnishes the name of a manufacturers' agent there who desires to receive catalogues and information relative to American-made machinery, gas engines, electrical goods, etc.

THE NEW YORK & NEW JERSEY TELEPHONE COMPANY is laying creosoted conduit made by the Wyckoff Pipe & Creosoting Company, of Stamford, Conn., for its underground wires in Brooklyn and Coney Island, N. Y., and Long Branch and Allenhurst, N. J. This creosoted conduit is popular for wires, and this telephone company has used many millions of feet of it during the past quarter century. Conduit laid by this company in Brooklyn 23 years ago is as sound and perfect as the day it was laid, showing no signs of decay.

NAIRN LINOLEUM COMPANY'S NEW PLANT.—Messrs. W. S. Barstow & Company, New York City, are consulting engineers for the Nairn Linoleum Company in the erection of an entirely new plant at Kearny, N. J., on the banks of the Passaic River. A feature of the power house equipment will be a 1000-kw, 60-cycle Allis-Chalmers steam turbine and alter-

nator wound for three-phase, 600 volts. The power house where this unit is to be installed will have an ultimate equipment of 4000 kilowatts, and the Passaic River will furnish the necessary cooling water. The Nairn Linoleum Company is one of the largest, if not the largest, institution of its kind in the world. The company is largely owned by Sir Michael Bairn, whose main works are located at Kilcady, near Edinburgh, Scotland. The American company is, however, operated independently of the one in Scotland.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was subjected to the influence of further liquidation of loans, special features being furnished by the resulting declines in both bond and stock issues, which carried prices in many cases to the lowest point of depression and completely overshadowed the plans of the Treasury for relieving the money market. At the close of the week the market was inclined to rally somewhat on covering of shorts, the decreased currency premium and gold engagements at Paris. The fact that the U. S. Steel 5 per cent bonds were again very unsteady attracted considerable attention. This was attributed, however, to the further sale of holdings received in exchange for Tennessee Coal stock. The U. S. Steel stocks held somewhat better, but naturally eased off slightly with the bonds. Various industrial stocks were affected by the reports of closing down of part of the establishments. General Electric was the only stock of its class that showed any marked improvement; the lowest price of the week was 104, but it advanced and closed at 109, this being a net gain of 4 points. Westinghouse closed at 34¾, which represents a net loss of 3¾ points. In the curb trading, prices fluctuated within a narrow range, the tendency being toward lower prices, as a result of further liquidation of various issues. Following are the closing quotations of Nov. 26:

NEW YORK.

	Nov. 18	Nov. 25		Nov. 18	Nov. 25
Allis-Chalmers Co.....	5	4⅞	General Electric 105		107
Allis-Chalmers Co. pfd..	14	12	Hudson River Tel.....	—	—
Am. Dist. Tel.....	20	—	Interborough Met. com.	5	5⅝
American Locomotive...	34½	35¼	Interborough Met. pfd..	15	15¾
Amer. Locomotive pfd...	90	85	Mackay Cos.	47	47½
American Tel. & Cable..	60	60	Mackay Cos. pfd.....	52¾	53⅜
American Tel. & Tel....	93	—	Marconi Tel.	—	—
Brooklyn Rapid Transit.	30½	31½	Metropolitan St. Ry...	23	—
Electric Boat	—	—	N. Y. & N. J. Tel.....	93	—
Electric Boat pfd.....	—	—	Western Union Tel....	62	60
Electric Vehicle	—	—	Westinghouse com.....	34	36
Electric Vehicle pfd.....	—	—	Westinghouse pfd 160*		—

BOSTON.

	Nov. 18	Nov. 25		Nov. 18	Nov. 25
American Tel. & Tel...	93¼	96⅜	Mass. Elec. Ry. pfd...	38	—
Cumberland Telephone..	—	—	Mexican Telephone.....	—	1¼
Edison Elec. Illum....195½		195¾	New England Telep...	96	99
General Electric 107		—	Western Tel. & Tel....	4	—
Mass. Elec. Ry.....	9½	9½	West. Tel. & Tel. pfd..	50	—

PHILADELPHIA.

	Nov. 18	Nov. 25		Nov. 18	Nov. 25
American Railways.....	44½	44	Phila. Electric	6⅝	6¾
Elec. Co. of America...	8	8	Phila. Rapid Transit...	12½	13
Elec. Storage Battery..	31¼	—	Phila. Traction	82½	82½
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Nov. 18	Nov. 25		Nov. 18	Nov. 25
Chicago City Ry.....150*		150	National Carbon	—	—
Commonwealth-Edison ..	—	—	National Carbon pfd...	—	—
Chicago Subway	—	—	Union Traction	—	—
Chicago Tel. Co.....105		—	Union Traction pfd...	—	—
Metropolitan Elec. com.	19*	19*			

*Asked

WESTINGHOUSE NOTES.—It is stated that Mr. George Westinghouse has submitted a proposition of settlement of his personal obligations, amounting to about $8,000,000. Most of these are in the form of notes, and the greater part of their proceeds were used to foster the Westinghouse enterprises. Of these notes banks and banking houses of Philadelphia hold about $2,000,000, while the remainder are held in New York, Pittsburg, Boston and Chicago. All these outstanding obligations are secured by collateral consisting chiefly of stocks of his various companies. According to the plan of settlement Mr. Westinghouse proposes to divide each of his notes into three equal parts, to be secured by the same collaterals now attached to them. The new notes are to run one, two and three years, and are to bear 6 per cent interest, payable at any time at his option. He is also to deposit additional collateral with five trustees, the majority of whom will represent his creditors. All the Westinghouse properties are doing a large and normally growing business.

WESTINGHOUSE ACTIVITY.—President George Westinghouse issued a denial on Nov. 25 of reports that the Westinghouse Electric & Manufacturing Company's plants will close down entirely on Dec. 1. President Westinghouse said: "In line with other industrial corporations the Westinghouse Company has been retrenching, but so far this curtailment does not much exceed 25 per cent. The Westinghouse Company continues to do a very large business, shipments for the East Pittsburg works in October aggregating $2,940,000. October was an unusually large month, and it is not expected that the November shipments will show up as well. However, it is believed they will reach and possibly exceed $2,000,000."

MANUFACTURE OF PHONOGRAPHS.—On the outburst of the recent financial storm, it was announced that the Edison Phonograph Works and other kindred concerns would limit production and cut down their forces. Officials of the Columbia Phonograph Company have now announced that they expect to resume rush work in the company's plant at Bridgeport, Conn., within a few days. When currency was scarce the company laid off a large number of men owing to the difficulty in securing cash for the payroll. Since then, the officials say, several hundred men have been put at work. Conditions are expected to become normal at the plant within a short time.

THE HANNAWA FALLS POWER COMPANY is remodelling its power plant, making many additions to its equipment and extending its transmission lines. When these alterations are completed, the company will have 2100 kilowatts at its disposal, which will be distributed to Potsdam, Gouverneur, Ogdensburg, Stella Mines and other nearby places. Mr. H. W. Connell, of Connell, Sykes & Connell, engineers, 90 West Street, New York, is consulting engineer in charge of this work and expects to have the remodelled plant in complete operation by spring.

UNION SWITCH & SIGNAL—It is estimated that the last quarter of the Union Switch & Signal Company will show results almost as favorable as reported in the first three quarters. Net earnings for the year are estimated at $1,100,000 on a total capital stock of $2,500,000 and outstanding bonds of $243,000. The company is free from debt. It has about $1,250,000 of "accounts receivable," and enough money in the bank to meet the payroll for two months, even if another cent is not collected in that time. It has absolutely no commitments or entanglements of any sort.

EL PASO NOTE ISSUE.—Stone & Webster, of Boston, are offering at 92 and interest, yielding an income of 8 per cent, $350,000 five-year 6 per cent notes of the El Paso Electric Company, Texas. The notes are convertible into common stock at par and are issued to take up $200,000 floating debt and provide improvements and extensions. The notice of sale states that for the year ended Sept. 30 the company earned $474,875 gross; operating expenses were $364,530; interest charges, including issue now offered for sale, $75,202, leaving a surplus for the stock of $34,400.

DIVIDENDS.—The Philadelphia Electric Company has declared a regular semi-annual dividend of 2½ per cent payable Dec. 16. The Norfolk, Va., Railway & Light Company has declared a dividend of 1½ per cent payable Dec. 1. The directors of the Multiphone Operating Company have declared the regular monthly dividend of 1 per cent payable Dec. 2. The Kings County Electric Light & Power Company has declared the regular quarterly dividend of 2 per cent on the capital stock of the company, payable Nov. 30.

CAMBRIDGE, MASS., NEW STOCK.—The Board of Gas and Electric Light Commissioners of Massachusetts has authorized the Cambridge Electric Light Company to issue 800 shares of additional capital stock, to be offered for sale to the stockholders of the company at $175 per share. Of this number, the proceeds of 170 shares are to be applied to the cancellation of an equal amount of the promissory notes of the company, and of the remaining 630 shares to the payment of cost of necessary additions to the plant.

ELECTRIC SWITCH PLATE RECEIVER.—In the Hartford County Superior Court, on Nov. 18, Judge Ralph Wheeler confirmed the appointment of Ernest McC. Stager as temporary receiver of the Electric Switch Plate Company, of Hartford.

HEINZE ELECTRIC COMPANY, of Lowell, Mass., has suspended business temporarily on account of the financial stringency. It has been making a line of X-ray and wireless telegraph apparatus.

GENERAL NEWS

Construction News.

BIRMINGHAM, ALA.—The Coosa River Electric Power Company is considering the project of developing power on the Coosa River at Ten Island Shoals, about 48 miles from Birmingham. Roswell H. Cobb is president.

COLUMBIANA, ALA.—E. N. Cunningham, of New Orleans, La., has been engaged by the Columbiana Light & Power Company to prepare plans and specifications for the installation of an electric light plant. Bids will be received for equipment as soon as plans are prepared.

MOBILE, ALA.—The Tidewater Development Company, which was incorporated with a capital stock of $10,000,000 for the purpose of transporting coal from the Warrior River mines in North Alabama to New Orleans, La., through the Lake Bergne Canal and Mississippi Sound, has commenced work on the construction of an electric railway from Tuscaloosa to Birmingham, for the purpose of making connection with the river end of the line.

VAN BUREN, ARK.—The Fort Smith Light & Traction Company, of Fort Smith, has applied for an extension of its electric light franchise in this town, and proposes to double the present number of street lamps.

CHICO, CAL.—The bid of L. D. Macy of $50 for the electric franchise granting permission to construct and operate an electric light, heat and power system in the city was accepted by the City Council. Mr. Macy states that a small plant will be built at first and enlarged as the demands increase.

EUREKA, CAL.—The North Mountain Power Company will install an 1100-kw transformer at its sub-station in the East End in January, so as to utilize the electrical energy from its plant in Trinity County.

FRESNO, CAL.—The Fresno Home Light & Power Company is making investigations in regard to future operations of its enterprise. The directors are considering an enlargement of the scope of its operations, and are considering the proposition of laying a pipe line from Coalinga to convey oil to Fresno for sale to general consumers. The line would be 45 miles long and would cost approximately $80,000. The company proposes to use crude oil as fuel for the operation of its light and power plants. This company was formed to furnish light and power to compete with the San Joaquin Light & Power Company. H. H. Hart, of San Francisco, is president of the company.

LONG BRANCH, CAL.—The Edison Electric Light Company is planning to erect a new plant here soon after the first of the year, the cost of which is estimated from $100,000 to $150,000.

LOS ANGELES, CAL.—The Board of Public Works has been authorized by the City Council to purchase 831 miles of copper telephone wire for use in connection with the Los Angeles aqueduct, the cost of which is estimated at $60,000. The wire will be used for telephone connections and for power transmission for the cement plant and the railroad near Tehachapi. The Board is preparing to advertise for bids for the transportation of supplies to the Los Angeles aqueduct, involving the construction of a railroad from Mojave to Owens Lake that will parallel the aqueduct. If satisfactory bids are not received the Board of Public Works will have to construct the road.

MONTEREY, CAL.—The new power station of the Monterey County Gas & Electric Company is nearly completed and will soon be placed in operation. The equipment of the plant consists of two 300-kw Curtis steam turbo-generator sets, Babcock & Wilcox water-tube boilers with oil furnaces, and one 300-kw and one 125-kw motor generating sets, which will be used to furnish power for the street railway system. The new station adjoins the old power house, which will be dismantled as soon as the new plant is placed in operation. William P. Hill is general manager of the company.

PASADENA, CAL.—The City Council has awarded a contract to the Fort Wayne Electric Company for electrical transformers for the municipal electric light plant.

SAN BERNARDINO, CAL.—The Lytte Power Company, of San Bernardino, and the Home Gas & Electric Company, of Redlands, have signed a contract which calls for a transmission line connecting the two plants, by means of which each plant will supplement the other. The work of extending the present system to all parts of the resident sections will be taken up as soon as the line from Redlands is completed.

SAN DIEGO, CAL.—The Consolidated Gas & Electric Company has reduced its rates for electric service and proposes to double the capacity of the plant, the work of which will be carried out at once. Some of the additional equipment and machinery is already en route. The capacity of the gas plant is also to be increased, and orders for additional equipment are to be placed in a short time.

SAN FRANCISCO, CAL.—The Parkside Traction Company has been granted a franchise to construct an electric railway in the southeast part of the city. Work has commenced on the construction of the road and it is expected to have it completed within two months. J. E. Green is president of the road.

SANTA ROSA, CAL.—The Board of Supervisors of Sonoma County has granted the Snow Mountain Water & Power Company a franchise to erect 25 additional transmission lines to be feeders from its main wires. The company bid $250 for the franchise. The company is building a power plant on the Eel River and will have a large reservoir in the mountains near Ukiah, and intends to extend its transmission lines to San Francisco to furnish electricity there, and also to the entire territory between Potter Valley and that city.

WHITTIER, CAL.—The Hadley Land & Water Company has leased the Laguna Ranch of 3500 acres and will install three power plants, develop water for the entire tract, drill artesian wells and put in a 5,000,000 gallon reservoir. The company will spend about $20,000 for the power plants and pipe line and $10,000 additional in drilling wells.

WILLOWS, CAL.—The Snow Mountain Power Company has been granted a permit to occupy a right of way within the Stony Creek national forest in northern California for a dam 16 feet high, a conduit approximately three miles long and a power house covering about three acres.

WILLOWS, CAL.— The Willows Water & Light Company, which was recently purchased by the Northern California Power Company, has been reorganized and the following named officers elected: E. V. D. Johnson, of Redding, president; P. H. Green, of Willows, vice-president; Samuel Boyd, secretary and manager.

CANON CITY, COL.—Ira Mowry, vice-president of the Canon City & Royal Gorge Electric Railway Company, announces that the money has been secured for the construction of the road. The bonds have been underwritten by the banking company of Coggshall & Hicks, of New York City. Surveys are now being made by City Engineer Milton for the line to the lime quarries, which the company owns on the Royal Gorge division, five miles from the city. As soon as the survey is completed bids will be received for the construction of the road and work will commence in a short time.

DENVER, COL.—The contract for the electrical equipment for the auditorium building has been awarded to the Northwestern Electric Equipment Company, of St. Paul, Minn. The contract amounts to about $40,000 and includes a complete electrical system and generating plant. A. J. Perky, superintendent of the Northwestern Electric Equipment Company, has charge of the installation of the plant.

QUINCY, COL.—E. D. Bannister is contemplating building a power plant to supply power to the Genesee Valley mining district.

BRANCHVILLE, CONN.—The Monarch Mining Company is making arrangements to equip its plant with electric light, and will also install air compressors for operating machinery in the quarry.

HARTFORD, CONN.—The Hartford Electric Light Company is seeking the privilege to distribute electricity within the limits of the town of East Hartford. The company now furnishes electricity in the fire district, but is anxious to extend its service to the outlying sections.

PLAINVILLE, CONN.—The citizens have voted to replace the Welsbach system of lighting with electric light service, and have instructed the selectmen to make a contract with the Connecticut Company for the illumination of the town.

STONINGTON, CONN.—The managers of the new electric lighting company, which is to supply Westerly, Stonington and Mystic with a 24-hour service, are preparing to take possession of the overhead plant now controlled by the Mystic Gas & Electric Light Company.

WASHINGTON, D. C.—The Secretary of the Interior has awarded a contract to the Roebling's Sons & Company, of Trenton, N. J., for furnishing approximately 685,000 pounds of copper wire required for the transmission line and other purposes in connection with the Salt River irrigation project in Arizona.

WASHINGTON, D. C.—In the annaul report of Rear Admiral Holladay, chief of Bureau of Yards and Docks, the sum of $628,000 is asked for improvements to the Brooklyn Navy Yard, which include an extension to the electric plant, at an estimated cost of $40,000; underground conduits extensions, at $25,000; telephone system extensions, at $12,000, and central power house to cost $231,000. The amount required for the League Island Navy Yard is estimated at $993,225, which includes electric elevators, $8,000; electric motors for dry dock No. 1, $35,000; extension of electric conduit system, $8,000, and central power plant extension, $322,500.

WASHINGTON, D. C.—Bids will be received at the office of Indian Affairs, Department of the Interior, until Dec. 27, for the construction of a dormitory, hospital, power house and electric lighting system at Tulalip School, Wash., in accordance with plans, specifications and instructions to bidders, which may be examined at the office of Indian Affairs, offices of the *Post-Intelligencer*, Seattle, Wash.; *Ledger*, Tacoma; *Morning Oregonian*, Portland, Ore.; *Herald*, Everett; *Pacific Builder and Engineering Record*, Seattle, Wash.; U. S. Indian Warehouses at Chicago, Ill., Omaha, Neb., St. Louis, Mo., San Francisco, Cal., and at the school. For further information apply to Charles M. Buchanan, superintendent Tulalip, Wash.

JACKSONVILLE, FLA.—The A. A. Kind Electric Company is planning to make extensions to its system next summer, which include the installation of an ice plant, water works and gas plant. A. A. Kind is manager.

LEESBURG, FLA.—The city is considering the question of issuing bonds for the construction of an electric light plant.

PALMETTO, FLA.—The Manatee Light & Power Company has extended its electric lighting system from Bradentown to Palmetto, across the river by cable.

AMERICUS, GA.—Plans have been completed for the new power plant of the Americus Railway & Light Company, and contracts will soon be awarded for equipment of the plant. It is expected to have the plant completed and ready for operation by next May. The cost of the plant is estimated at $200,000.

ATLANTA, GA.—The contract for the construction of the Atlanta-Augusta Interurban Railway has been awarded to the Cook & Laurie Company, of Montgomery, Ala., and orders for the equipment of the line will be placed immediately.

LAGRANGE, GA.—The mayor writes that about $20,000 will be expended for improvements to the municipal electric light plant, bids for which will probably be called for in February. J. R. Black is superintendent.

MARIETTA, GA.—The Marietta-Macland Railway Company will apply for a charter about Dec. 1, and will call for a capitalization of $500,000 with the privilege of increasing it to $1,000,000. The company propores to build an electric railway from Marietta to Powder Springs. John N. McEachorn, of this city, is interested in the enterprise.

IDAHO FALLS, IDAHO.—The Idaho Power & Transportation Company, Ltd., is constructing a transmission line from its station near Idaho Falls to St. Anthony. The line will be completed to Rigby, a distance of 24 miles, in about 30 days. Two more installations similar to the one now in operation, which consists of a 400-hp water wheel and a 225-kw generator, will be put in operation by Jan. 1, 1908. The company furnishes 100 horse-power to the municipal electric light plant in Idaho Falls, and will operate lighting plants at Rigby and other towns.

MULDOON, IDAHO.—R. T. Tustin contemplates installing an electric light and power plant for the mills.

CHICAGO, ILL.—Sanction was given to the consolidation of the Chicago Edison Company and the Commonwealth Electric Company into the Commonwealth Edison Company by an opinion presented by the Assistant Corporation Counsel Miller to the Council committee on gas, oil and electric light, on Nov. 20, on which the committee took immediate action. The opinion also answers questions referring to rates and franchise rights of the electric company. Under the consolidation the Commonwealth-Edison Company will operate under the Commonwealth ordinance, which requires the company to pay the city three per cent of its gross receipts, which will make a total of something over $225,000 a year.

BEDFORD, IND.—The City Council has granted a 50-year franchise to the Grand Central Traction Company for the construction of an interurban railway through the city and also to construct and operate an electric light system. The company has also applied to the City Council in Bloomington for a similar franchise.

WINCHESTER, IND.—The Citizens Water & Light Company is contemplating starting a day service May 1, 1908, and will be in the market for motors and all equipment for power service. Carl R. Seamans is manager.

ATLANTIC, IOWA.—Bids will be received until Dec. 7 by T. E. Nichols, city clerk, for a triplex or power pump to be driven by a steam engine operating under 80 lbs. boiler pressure or by electric motor capable of performing the service from a depth of 26 feet and against a head of 90 to 160 lbs. with a capacity of 700,000 gallons in 24 hours.

MARSHALLSTOWN, IOWA.—It is expected that work will soon commence on the surveys and estimates for the new interurban railway, which is to be built from Marshalltown to Melbourne. C. H. Peck, of Chicago, Ill., will have charge of the work.

PELLA, IOWA.—W. H. Fowler has made application for a franchise to install an electric light plant.

PLEASANTVILLE, IOWA.—The citizens have voted to grant the Swan Telephone Company a franchise to erect and maintain a telephone system in the town.

CLAY CITY, KAN.—The directors of the Clay Center Telephone Company are contemplating extensive improvements to the local system.

HOLTON, KAN.—The Holton Electric Company has applied to the circuit court for permission to dissolve. The company is capitalized at $30,000 and was organized to light the town of Holton. The stockholders are Clarence A. Rose, Charles D. Mill and Jay M. Lee, of Kansas City, and B. E. Ninde, of Oskaloosa, Ia.

SHREVEPORT, LA.—Application has been made to the Council by John Lorenz, of Jackson, Miss., for a franchise to construct a street car line to the cemetery.

MORRILL, ME.—Herman Merriam has recently installed a dynamo in his mill to furnish electricity for lighting.

STRONG, ME.—The Strong Lighting & Improvement Company is to establish a power plant here at a cost of $10,000.

BALTIMORE, MD.—The stockholders of the Consolidated Gas, Electric Light & Power Company on Nov. 20 voted to lease the property of the Baltimore Electric Company. The lease is to run for 999 years, and under its terms the Consolidated Company will pay the Baltimore Electric Company an annual sum equal to the interest on the bonds outstanding and the interest on its outstanding 5 per cent preferred stock, provided that the company does not earn these requirements. As an outcome of the consolidation, it is said that the Maryland Telephone Company, which is controlled by the Baltimore Electric Company, will be taken over by the Chesapeake & Potomac Telephone Company.

AMHERST, MASS.—The Connecticut River Power Company has completed the transmission line from its plant at Turners Falls to Amherst, a distance of 20 miles. The plant has a rating of 3000 horse-power, and will supply electricity in Amherst, Pelham, Hatfield, Sunderland and South Deerfield. Electricity will also be furnished to manufacturers. The steam plant in Amherst will be held in reserve for emergencies. C. Fred Duel is president of the company.

BARRE PLAINS, MASS.—Arrangements have been made for installing an electric lighting system along the road between South Barre and Barre Plains and in the village of Barre Plains. The committee appointed by the town has made a contract with the Barre Wool Combing Company, which has an electric plant at South Barre, to supply electricity for the system. Under the terms of the contract the company is to install the plant and have it in operation not later than Jan. 1. An appropriation of $1,000 has been made, which will pay for installing the system and maintaining the lamps for one year.

CAMBRIDGE, MASS.—The Board of Gas and Electric Light Com missioners has authorized the Cambridge Electric Light Company to issue 800 shares of additional capital stock to be offered for sale to the stockholders of the company at $175 per share, the proceeds of 170 shares to cancel an equal amount of indebtedness and the remaining shares to pay cost of addition.

CHESTER, MASS.—At a hearing before the State Board of Gas and Electric Light Commission the Chester Electric Light Company agreed to furnish electricity for lighting the streets at once, the price to be fixed later by the commission, when they render its findings for the whole case. The streets have been in darkness for some time owing to a disagreement between the town officials and the electric light company in regard to the price charged for street lamps.

FORT REVERE, MASS.—Bids will be received until Dec. 10 by C. O. Zollars, captain artillery corps, at the office of the quartermaster, for furnishing and installing electric lighting fixtures in the hospital at Fort Revere.

GARDNER, MASS.—The Board of Gas and Electric Light Commissioners has authorized the Gardner Electric Light Company to issue $35,000 in capital stock and first mortgage bonds to the amount of $65,000.

GARDNER, MASS.—A new oil engine of 225 horse-power has been received by the Gardner Electric Company and will soon be installed in its plant, which makes the second engine of this type to be added to the station within a month.

LINCOLN PARK, MASS.—It is reported that the Lapointe Machine Tool Company and the Universal Boring Machine Company have practically decided to co-operate and install a power plant to generate electricity to furnish light and operate motors for both companies. A 75-hp steam engine or a Nash triple gas engine will be used. The power plant will be able to supply power for additional industries that may locate here.

NEWTONVILLE, MASS.—Bids will be received until Dec. 2 by George H. Elder, commissioner of public buildings, for furnishing a ventilating and heating plant and an electric plant for the technical training high school to be erected at Walnut Street and Elm Road. George F. Newton, 6 Beacon Street, Boston, Mass., is the architect.

PITTSFIELD, MASS.—Fred D. Retallic & Company have been awarded the contract for the electric wiring of the new armory building. The contract calls for about 400 incandescent lamps, an electric signal service and a telephone system connecting all parts of the building.

SALEM, MASS.—Martin Kelley & Company have installed two 10-hp electric motors in their factory at Tapleyville, displacing steam with electric power.

SPRINGFIELD, MASS.—The United Electric Light Company has applied to the State Board of Gas and Electric Light Commissioners for permission to increase its capital stock sufficient to realize $750,000 to pay for floating indebtedness incurred in making improvements and extensions to its property.

ALMA, MICH.—The Alma Grain & Lumber Company is planning to install a new water wheel and dynamo in its electric plant. L. A. Sharp is treasurer.

CRYSTAL FALLS, MICH.—Work has commenced on the construction of the new power house for the municipal electric light plant.

GRAND RAPIDS, MICH.—The Fowlerville Lighting Company has been incorporated with a capital stock of $15,000.

LUDINGTON, MICH.—It is reported that the electric light and power plant of the Pere Marquette Railroad Company in this place is to be removed from the city soon.

MANISTEE, MICH.—R. G. Peters Salt & Lumber Company, of this city, is reported to be considering a project to build an interurban electric road between Manistee and Cadillac. The company is making preliminary plans for a dam on Pine River in South Branch Township, where electricity could be generated.

MARQUETTE, Mich.—The Calumet & Lac la Belle Traction & Power Company, it is said, will soon be organized for the purpose of constructing an electric railway between Calumet and Lac la Belle. S. M. Wells, of Chicago, is promoting the enterprise.

STEWARTVILLE, MINN.—J. S. Danneck, manager of the Stewartville Electric Light Company, writes that the company will expend between $1,200 and $1,500 for improvements to its plant.

SHERBURN, MINN.—A special election was held Nov. 19 to vote on the proposition that the village purchase and operate the electric light plant, which was defeated by three votes.

FARIBAULT, MINN.—F. C. Nelson, of St. Paul, has purchased the plant of the Polar Star Electric Company and will make improvements to the same.

KANSAS CITY, MO.—The County Court has confirmed the granting of the right of way of the Blue Valley Railroad to operate an electric railway to a point on the Blue River. The company was financed some time ago and plans have been drawn for the building of the road, which will commence at an early date. The officers of the company are Alexander Massey, president; P. G. Walton, of Anthony, Kan., vice-president; Joseph S. Chick, secretary and treasurer, and D. W. Pike, chief engineer.

MAYSVILLE, MO.—The citizens will be asked to vote on a proposition to issue $10,000 in bonds for the construction of an electric light plant.

ST. JOSEPH, MO.—The Interstate Railway Company has filed for record a mortgage upon all its property to secure a bond issue of $4,050,000 to the Carnegie Trust Company, of New York, N. Y. The company was organized to build an electric interurban railway between St. Joseph and Kansas City, and the present mortgage will provide ample funds for the purpose.

SPRINGFIELD, MO.—The City Council on Nov. 6 renewed the lighting contract with the Springfield Gas & Electric Company. The rate for each street lamp is $67.50 per year.

FREMONT, NEB.—Frank Hammond, secretary Board of Public Works, writes that former bids for the construction of the water works and electric light station have been rejected, and new bids have not yet been called. The cost of the work is estimated at $25,000. Contracts for engines and dynamos have been awarded. C. A. Chapman, of Chicago, Ill., is consulting engineer.

ELY, NEV.—William B. Thompson has applied to the City Council for a fifty-year blanket franchise covering all streets and alleys in the town of Ely, in return for which he proposes to build and equip an electric railway between the depot at Ely City and the town of Ely.

WONDER, NEV.—Negotiations are now in progress to secure electricity for lighting and power for the town of Wonder from Carson City.

MANCHESTER, N. H.—The State Railroad Commissioners have granted the Manchester Street Railway permission to increase its capital stock by $275,000, the proceeds to be used for improvements that have already been made and for further improvements and extensions, the cost of which is estimated at $83,330.

VINELAND, N. J.—The stockholders of the Vineland Gas & Electric Company have asked for a receiver for the company. While the company is in good financial condition, it is brought into litigation through some defect in the incorporation. Certain stockholders have applied to the United States Court for a receiver to be appointed pending the correction of its incorporation, which was demurred by Walter Wood, who was desirous of taking over the company and continuing as an individual.

BAY SHORE, N. Y.—The Bay Shore Gas & Electric Light Company is planning extensive improvements and extensions to its plant, and will establish a 24-hour service for light and power after Feb. 1. The company will expend about $35,000 for improvements, which will include a 100,000-ft. storage holder, a 200-hp steam engine, a 150-hp boiler, and a 110-kw generator and extension of mains, etc.

BROOKLYN, N. Y.—Bids will be received by the Commissioner of Water Supply, Gas and Electricity, at the office of the Department of Water Supply, Gas and Electricity, 21 Park Row, Borough of Manhattan, until Dec. 6, for furnishing and delivering special crossheads for lamp posts in the Borough of Brooklyn. John H. O'Brien is commissioner.

CANANDAIGUA, N. Y.—Owing to a break in the machinery in the power plant at Littleville, and low water in the lake, the Ontario Light & Traction Company has experienced considerable difficulty in lighting the streets of the village, which has partly been remedied by the installation of a new generator in the power station of the Rochester & Eastern Rapid Railway Company, at Canandaigua.

LITTLE FALLS, N. Y.—The Hudson River Electric Company has applied to the Common Council for an extension of one year's time for fulfilling the conditions of the company's franchise to operate in this city. By the terms of the franchise the transmission line was to be completed and in operation by Dec. 1 of this year. The delay has been caused by the condition of the money market. C. H. Peddrick is president of the company.

SYRACUSE, N. Y.—The Syracuse & Suburban Railroad Company is enlarging its auxiliary power plant at Oroville, at a cost of about $3,000.

SULPHUR SPRINGS, N. C.—Plans are being prepared by Smith & Powers for a combined electric light plant and water works system, to cost about $25,000.

WAYNESVILLE, N. C.—The Waynesville Electric Power Company is contemplating developing other water powers and installing further equipment in its plant. George E. Ladshaw, of Spartansburg, S. C., is the engineer.

KENMARE, N. D.—The Kenmare Light & Power Company is considering the question of installing another 100-kw generator and may add another boiler to its plant. F. W. Amsler is manager.

ASHVILLE, OHIO.—Bids are being asked for a complete street lighting system for this place. Arrangements have already been made for securing current from the Scioto Valley Traction Company, which has a sub-station near here.

CLEVELAND, OHIO.—The Council committee on Nov. 20 approved the franchises of the Cuyahoga Heat & Light Company. Under the terms of the franchise the maximum charge for electricity for lighting is 5½ cents per kw-hour. John C. Keyes, president of the company, states that the company will build four plants like the present one in Hickox Alley, within two years, at a cost of $2,000,000, and will give a service of 5000 kw. Revocation of the franchise may be made at any time for violations of its provisions, and the entire plant may be acquired by the city at a valuation of the cost of reproduction, less depreciation, plus 10 per cent. Heating is to be charged for at the rate of not more than 27½ cents per sq. ft. of radiation area.

DEFIANCE, OHIO.—The Toledo & Defiance Railway Company and the Defiance, Hickville & Fort Wayne Railway Company, subsidiary organizations of the Toledo, Wabash & St. Louis Railway Company, have been granted 25-year franchises to construct and operate electric railways in Defiance.

MARION, OHIO.—A new corporation headed by H. D. Critchfield, of Milwaukee, Wis., has applied to the City Council for a 25-year franchise to install a telephone system in this city and county. The Belle and Marion County Telephone Companies were recently merged. The new company will be capitalized at $250,000.

CLINTON, OKLA.—The City Council has granted F. Murch, of Hennessy, an electric light and power franchise, and has also contracted for 20 street lamps.

PANAMA.—Bids will be received until Dec. 23 at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., for electrical material consisting of cable, wire, flexible conduit, wire attachments, switches, push buttons, shade holders, lamp shades, electroliers, incandescent globes, dry cells, wire grips, bit braces, etc. Blanks and general information relating to this circular (No. 405) may be obtained from this office or at the offices of the assistant purchasing agents, 24 State Street, New York City; Custom House, New Orleans, La.; also from the U. S. Engineer offices in the following cities: Baltimore, Md.; Philadelphia, Pa.; Pittsburg, Pa.; Boston, Mass.; Buffalo, N. Y.; Cleveland, Ohio; Chicago, Ill.; St. Louis, Mo.; Cincinnati, Ohio; Detroit, Mich.; Milwaukee, Wis.; St. Paul, Minn.; Chattanooga, Tenn.; Louisville, Ky.; and Mobile, Ala. H. F. Hodges, Lieut. Col. Corps of Engineers, U. S. A., is general purchasing officer.

CATASAUQUA, PA.—A. N. Ulrich, who as receiver has been in charge of the properties of the Lehigh-Northampton Gas & Electric Company for some time, has turned the same over to the owners, who have perfected organization by electing the following-named officers: M. L. Finckel, president; Horace Evans, secretary and treasurer, and G. W. Steele, manager. The name of the company has been changed to the Lehigh & Northampton Light, Heat & Power Company. The company furnishes gas and electricity for light, heat and power in Catasauqua, Fullerton, Hookendauqua, Coplay, Northampton and Siegfried.

HARRISBURG, PA.—The proposed extension of the Penn & Franklin Street Railway Company from Johnston Street in Wilkinsburg to the dividing line between Braddock Township and North Braddock, has been approved by Governor Stuart. The road will be over private right of way and will be about three miles long.

HARRISBURG, PA.—The following companies have filed a notice of increase of indebtedness with the Secretary of State: The Philadelphia & Garrettsford Street Railway Company has increased its indebtedness from $300,000 to $800,000; The Buffalo & Lake Erie Traction Company from $4,505,000 to $4,755,000 for extensions and betterments to its system; the Newton Railway Company from nothing to $375,000.

HUNTINGTON, PA.—Contracts have been awarded by the Raystown Power Company to the Ayrens Construction Company, of Lewiston for the construction of dam No. 1 to be built on the Raystown branch of the Juniata River. This dam will be built about nine miles from the confluence of the Raystown branch with Juniata. The plans call for a dam 40 feet in height, with a storage capacity of seven and one-half square miles, and is estimated to furnish about 400 horse power. The cost of the dam is estimated at about $100,000. The company will also be provided with an auxiliary steam plant, which will be located somewhere in the coal fields contiguous to its water-power plants, and will have a capacity of 10,000 horse power. The Juniata Electric Company, organized by William P. Woods, of Lewiston, and Wallace Wilson, of Huntington, will be the distributing medium for the electricity generated by the Raystown Power Company.

JOHNSTOWN, PA.—The Johnstown Electric Railway Company has filed articles of incorporation with a capital stock of $50,000 by John B. Morgan, E. V. Remington, Charles M. Moses, of Johnstown.

NEW CASTLE, PA.—The Mahoning & Shenango Valley Railway & Light Company is said to be contemplating extending its line from New

Castle to Greenville, a distance of 11 miles. The Meadville-Conneaut Lake Company is planning to build a line between Linesville and Greenville, 21 miles in length, which will give a through electric railway between New Castle and Pittsburg.

PHILADELPHIA, PA.—Only one bid was received by the Department of Public Safety, which was opened Nov. 15, for lighting the streets by electricity for next year, which was submitted by the Philadelphia Electric Company, which holds the contract for the present year. The prices submitted are the same as this year, but the increase in number of lamps will make the cost of electric lighting next year $1,200,000, as compared with $1,114,224 this year. The price per lamp ranges from 25 to 29 cents per lamp per night.

PITTSBURG, PA.—The City Council has passed an ordinance providing for a contract for three years for furnishing the city with arc lamps at a cost not to exceed $280,000.

PITTSBURG, PA.—On account of present financial conditions the Duquesne Light & Power Company is not doing any construction work on its proposed new plant or purchasing any machinery. The company plans to construct a large plant on the Monongahela River at a cost of more than $1,000,000.

READING, PA.—The Nolde & Horst Company has placed a contract with the Brown Engineering Company for the electric light and power equipment for its new knitting mill. The machinery will be operated by individual motors.

SHAMOKIN, PA.—The Town Council has awarded the contract for street lighting to the Shamokin & Coal Township Light Company for a term of ten years.

UNIONTOWN, PA.—The Brownsville, Masontown & Smithfield Railway Company has been granted a franchise by the Borough Council of Smithville to operate a street railway over certain streets in the borough.

WAYNESBORO, PA.—The construction committee of the Chambersburg, Greencastle & Waynesboro Electric Railway Company is considering the question of providing power for the extension now being built between Greencastle and Chambersburg. The committee has recommended that additional machinery be installed in the Waynesboro power plant to supply electricity for operating the road. The plan as adopted by the directors provides for the transmission of alternating current to Kauffmans by overhead wires, where it will be converted to operate the cars.

WELLFORD, S. C.—The Enoree Power Company is constructing a hydro-electric power plant on the Enoree River at Wellford, and will furnish electricity for lighting and power in Woodruff, and for power at Fountain Inn. Ladshaw & Ladshaw, of Spartansburg, are the engineers.

FREEMAN, S. D.—The citizens and business men of Freeman have petitioned the City Council to take steps to secure the establishment of an electric light plant in the city.

CARTHAGE, TEX.—John C. Whitney, owner of the Carthage electric light plant, writes that he is contemplating installing a larger engine and boiler or gas engine in his plant.

ELGIN, TEX.—B. H. Graham, of Smithville, writes that a stock company is about to be formed to construct an electric light plant, water works and an ice plant, to cost between $50,000 and $60,000. The company will be ready for plans about Jan. 1. No engineer has yet been selected.

EL PASO, TEX.—A 500-kw generator was recently damaged in the plant of the El Paso Electric Railway Company by an explosion, causing a loss of $10,000.

FORT WORTH, TEX.—Bids will be received at the office of James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., until Dec. 20, for the installation of a conduit and electric wiring system for extension to U. S. post office in Fort Worth.

NEWFANE, VT.—The citizens are considering the question of having the streets of the village lighted by electricity. The company owning a mill just south of the village, of which James F. Chase, of Boston, Mass., is manager, contemplates installing an electric plant for lighting the mill, and a contract may be made with the company to install a plant of sufficient capacity to light the village.

RUTLAND, VT.—The Rutland Railway, Light & Power Company has made a contract with the Rutland Railroad Company to install two 40-hp electric motors and complete apparatus to equip the car and machine shop of the railroad company with electric power. The steam plant will be abandoned.

CHENEY, WASH.—The new flour mill of the F. M. Martin Company has been placed in operation. The motive power is electricity, which is supplied by the Washington Water Power Company. The power company is furnishing electricity for the street lighting service and for power purposes in this town, and has established a 24-hour service, which began Nov. 11.

PORT TOWNSEND, WASH.—The Pacific Electric Company has submitted a proposition to the City Council which contemplates the installation of a water wheel, dynamos, transformers, with outside system and connections for operating 50 arc lamps, at an estimated cost of $11,061.

SPOKANE, WASH.—It is reported that the Panhandle Electric Railway Company is making arrangements to commence work on the construction of its road, and will begin at once work on the construction of a large power plant on Priest River to furnish electricity to operate the railway. The company will also sell power to the mines in the Priest Lake district. Arrangements have been completed between the company and the government for the construction of a telephone service along the new road and reaching into the Priest River Forest Reserve. Half of the cost of the erection of the telephone system will be borne by the government.

BLUEFIELD, W. VA.—The Bluestone Traction Company has been granted a franchise to extend its line on South Bland Street and into South Bluefield. The franchise is for a term of 47 years, in return for which the company is to pay the city $10,000.

FAYETTEVILLE, W. VA.—The Fayetteville Water & Light Company has been granted a 50-year franchise and will soon commence work on the construction of an electric light system. John Hawkins is interested in the enterprise.

SHEPHERDSTOWN, W. VA.—John A. Livers, of Lancaster, Pa., and M. P. Thorn, of Martinsburg, W. Va., who recently purchased the municipal electric light plant in this town and secured a franchise for 30 years, will organize a company. Electrical energy will be secured from the plant of the Martinsburg Light & Power Company at Martinsburg to operate the system, and ultimately power will be secured from the plant of the Martinsburg company now being built at dam No. 4. The transmission lines in Shepherdstown will be reconstructed.

ASHLAND, WIS.—The machinery of the new power plant at White River was put into operation for the first time Nov. 5. The company is now extending its lines to Ashland and will be ready to supply electricity in the city in about two weeks. The new power plant will develop 1000 horse power, and is under contract to furnish 500 horse power for a term of 25 years to the Ashland Light, Power & Street Railway Company. The company also holds an option on the additional 500 horse power that the dam is capable of supplying.

KAUKAUNA, WIS.—The Fox River Valley Telegraph & Telephone Company is planning to build an exchange in this city next summer.

MILTON, WIS.—The farmers of Johnstown and Richmond have formed a telephone company with a capital stock of $2,500. G. M. Holbrook is secretary.

LLOYDMINSTER, ALB.—The Lloydminster Telephone Company has offered to dispose of its plant and system to the provincial government. The offer will likely be accepted.

OKOTOKS, ALB.—At a meeting of the ratepayers it was decided to petition the Council to purchase the electric lighting plant of the Okotoks Electric Light & Power Company, which was closed down recently as it failed to meet expenses. Address W. Fisher.

VANCOUVER, B. C.—The Canadian Pacific Railroad has decided to electrify the Columbia & Western Railroad, in the boundary district. This is for the purpose of securing much of the freight developed by the Great Northern Railroad in late years, the company being able to operate far more cheaply by electricity than by steam. The West Kootenay Light & Power Company will supply the motive power. Address R. Marpole, general superintendent of the Canadian Pacific Railroad, Vancouver.

ST. VITAL, MAN.—The Town Council has decided to construct a municipal electric railway system and will rescind the contract given the Winnipeg Electric Street Railway Company for the construction of a railway system here. The secretary and treasurer has been instructed to secure the services of a civil engineer to prepare plans, specifications and estimates.

ST. JOHN, N. B.—The Nova Scotia Telephone Company has purchased the system of the Central Telephone Company, which operated 70 miles of pole line and 90 miles of wire between Bridgewater and Middleton.

HAMILTON, ONT.—The fire and water committee has decided to advertise for tenders for electric pumps for the water works system, and the competition will be open to foreign as well as Canadian manufacturers.

LONDON, ONT.—The City Council has passed on the first reading of the Niagara power by-law, and the special committee of the Council was authorized to instruct the engineer to prepare a statement of the estimated cost of distribution, and to prepare plans showing the area proposed to be covered.

PORT ARTHUR, ONT.—The Ontario & Michigan Power Company is seeking incorporation to develop electrical power on the Nepigon, Black Sturgeon and Pigeon rivers, north of this town. Address Andrew T. Thompson, Ottawa, Ont.

TORONTO, ONT.—The Stark Telephone, Light & Power System, Ltd., which supplies electricity for light and power in Toronto Junction, has been obliged, owing to the financial stringency, to go into liquidation. The company will probably be reorganized.

TORONTO, ONT.—Various plans and estimates for a municipal plant for the distribution of electricity in the city of Toronto were submitted at a conference held at the Mayor's office Nov. 15, between the city officials, representatives of the Hydro-Electric Power Company and engineering experts. There were seven propositions presented, ranging from $1,775,000 to $5,250,000. Three plans were presented by W. C. Chase, of the firm of Smith, Kerry & Chase; the other plans were from the engineers of the Hydro-Electric Power Commission. If one of the estimates is selected the citizens will be asked on Jan. 1 to vote on the question of issuing bonds for the same.

WOODSTOCK, ONT.—At the coming municipal election a by-law will be submitted to the ratepayers for the expenditure of $27,000 for a distributing plant for Niagara power, and to provide a new motor and electric pump, so as to utilize the electric power for the street lighting and the water works systems.

SASKATOON, SASK.—The Saskatchewan Power Company is applying for incorporation for the purpose of developing and distributing electricity. Stratton, Sutherland & Jordan, of this city, are acting for the applicants.

CORBONEAR, NFLD.—The United Towns Electrical Company, Ltd., is making arrangements to extend its service to other towns, work on which will commence as soon as possible. Louis Williams is superintendent.

Company Elections.

NEW YORK, N. Y.—At the annual meeting of the Electrical Securities Corporation, held recently, the retiring board of directors was re-elected with the exception that C. N. Mason was elected to fill the vacancy caused by the death of E. R. Coffin. The vacancy caused by the death of S. M. Hamill was not filled at this time. The office of vice-president, which was left vacant by the death of E. R. Coffin, was filled some time ago by the election of C. N. Mason.

DRUMBO, ONT.—The Princeton & Drumbo Telephone Company, recently incorporated, has elected the following officers: F. J. Daniel, president; T. Conway, vice-president; G. S. Smith, secretary; W. H. Wells, treasurer. The company proposes to operate in the following villages: Princeton, Drumbo, Eastwood, Gobles, and possibly Cathcart and Paris.

New Industrial Companies.

THE EDWARDS & MERRILL COMPANY (electricians), Boston, Mass., has been incorporated, with a capital stock of $25,000, by William G. Merrill, John E. Edwards and Samuel W. Culver.

THE ELECTRO-RADIATION COMPANY, of Boston, Mass., has been incorporated, with a capital stock of $25,000, by Frank W. Douglass, James Lynch, John J. Fischer and others.

THE MASON MOTOR FAN COMPANY, of Boston, Mass., has filed articles of incorporation, with a capital stock of $250,000. The incorporators are A. W. Crankshaw, John Mason and Fremont E. Shurtleff.

New Incorporations.

BIRMINGHAM, ALA.—Articles of incorporation have been filed for the Armstrong Light Company with a capital stock of $5,000. H. L. Armstrong is president.

MANITOU, COL.—The Manitou Incline Railway Company has filed articles of incorporation with the Secretary of State. The company is capitalized at $220,000, and has purchased the cable tram road from Manitou to the summit of Mount Manitou, a distance of one mile, from the Hydro-Electric Company. The line will be re-constructed and re-equipped for the tourist season of 1908.

CLINTON, ILL.—The Clinton Gas & Electric Company has been incorporated with a capital stock of $10,000 by James M. Surdam, John W. Smith, Rolla T. Ingham, Joseph Saenger, A. Saenger and Richard Lindauer. The company proposes to manufacture and sell gas and electricity.

FARMERSBURG, IND.—The Torr Electric Company has been incorporated with a capital stock of $20,000. The company has taken over the plant and holdings of A. D. Torr, which furnish electricity for light and power in Farmersburg and Shelburn, 6 miles distant. The officers of the company are: E. W. Jennings, president; A. D. Torr, secretary and general manager, and W. S. Buldridge, treasurer.

VINCENNES, IND.—The Black Hawk Light, Heat & Power Company has filed articles of incorporation with the Secretary of State with a capital stock of $1,000,000. Cyrus Hoffman, George H. Smith, H. S. Shoffer and others are the directors.

ARDMORE, I. T.—The Arbuckle Falls Light & Power Company has filed articles of incorporation with a capital stock of $100,000. The incorporators are Morris Saas, L. P. Adkins, F. B. McElroy and Mark Kirkpatrick. The company proposes to develop water power on Fallas Creek in the Washita River Canyon, near Ardmore, to generate electricity.

ENID, OKLA.—The Enid Pump & Power Company has filed articles of incorporation with a capital stock of $100,000. The incorporators are H. W. Sawyer, R. C. Dickensheets, A. W. Sawyer and others.

OKLAHOMA CITY, OKLA.—The Oklahoma City Street Traction Company has been granted a charter to build an interurban railway from Oklahoma City to Hollis, a distance of 119 miles, at an estimated cost of $10,000 per mile. The incorporators are: C. A. Swartz, J. P. Van Allen, C. E. Richardson, of Frederick; H. W. Curry, of Eaton; J. N. Street, of Bloomington, Ill.; F. B. Lucas, Samuel Ecker, J. E. Woodwroth and T. R. Clift, of Guthrie.

OKLAHOMA CITY, OKLA.—The Red River Railway Company has been granted a charter to construct an electric railway from a point on the Texas state line, north of Bonham, Tex., to Oklahoma City, a distance of 200 miles. The incorporators are: George F. Robertson, of Atoka; E. M. Abernathy, S. C. Hawk and F. J. Hawk, of Lexington; Albert Rennie, of Pauls Valley; F. P. Kibbey, of Byars; J. W. Hocker, of Purcell, and T. H. Bayless, of Durant.

TECUMSEH, OKLA.—A charter has been granted to the Rapid Transit Interurban Company with a capital stock of $2,500,000 to build an electric interurban railway from Muskogee via Tecumseh to Chickasha, a distance of 137 miles; also a line from Tecumseh to Guthrie, a distance of 55 miles, and also a line from Tecumseh to Sulphur, 55 miles in length. The headquarters of the company will be at Tecumseh. The incorporators are: John A. Clark, S. B. Mitchell, J. W. Sapon, G. M. Ceissnor, T. J. Ray and M. H. Tennion.

Legal.

DECISION ON MAGNET CONTROL FOR ELEVATORS.—Judge Van Fleet, of the United States Circuit Court for the Northern District of California, has handed down a decision in the case of the Otis Elevator Company vs. Van Emon Elevator Company, enjoining the latter from making and selling elevators containing what is called the magnet control, as being an infringement of a patent owned by the Otis company, known as the Baxter patent. This suit was begun several months ago, and a motion made for a preliminary injunction. The device infringed consists of a switch, located in the car, arranged and operated by electrical connections with the motor switch, whereby the motor can be started, stopped or reversed at the will of the operator, to start, stop or reverse the movement of the car. The Van Emon structure, while differing somewhat in minor details of construction, such as the use of push buttons, instead of a lever switch, and a solenoid instead of an electro-magnetic device of horseshoe form, was held by the court to be an infringement of the patent.

ELECTRIC GENERATOR LITIGATION.—We are in receipt of the following from the Allis-Chalmers Company: There has appeared in the technical and popular press an item to the effect that the General Electric Company obtained an injunction against the city of Nashville preventing the use of certain electric generators manufactured by the Bullock Electric Manufacturing Company. This statement is, however, misleading. The facts of the case are as follows: A motion for preliminary injunction was filed by the General Electric Company against the city of Nashville alleging infringement of the Parcelle patent. This patent, which has but a few months more to run, covers very specifically a mechanical device for fastening the laminated pole-pieces of a dynamo-electric machine in position on the frame. This construction was employed in a few machines manufactured several years ago by the Bullock Electric Manufacturing Company, before its affiliation with the Allis-Chalmers Company; but has since been abandoned for a better device. The city of Nashville was given sixty days from the date of the court's order within which to make the necessary changes to avoid infringement. The simple changes required were readily made by the Allis-Chalmers Company, within the time specified, in such a manner that the operation of the plant was not interfered with for a single instant.

CONTRIBUTORY FOOLHARDINESS.—In the case of Shade vesus the Bay Counties Power Company, the Supreme Court of California has held that the deceased plaintiff was guilty of contributory negligence. The facts are set forth concretely in part of the decision as follows, in favor of the company: "The deceased was not a backwoodsman who had never heard of electrical plants and the danger which lurks in live wires—if, indeed, such a person could be found in California. He had been born and had always lived in the city of Vallejo, where, as in nearly every American city, electricity is used, was a business man, 28 years old, and of good intelligence. He knew the danger of live wires, but was not an expert electrician. He had not been placed by the negligence of the appellant in a position of peril from which he must by some means extricate himself, so that he might have been excused if he had not used the best judgment in trying to avoid danger. He was in no danger whatever. It appears probable from the evidence that he and his party could have driven past without any risk, as the distance from the hanging wire to the edge of the road was, at the narrowest point, nine feet and nine inches. However, it was not necessary for them to drive past. They could have turned back, and, if they could not have reached their original destination by some other road, they could have had their picnic at some other place; and, if they had suffered any serious wrong by the obstruction, they could have recovered damages. They were not even tempted by any business interests to incur the danger of trying to remove the wire, nor were they impelled by any sense of duty to do so. They were traveling merely for the purpose of pleasure. Exactly how near the deceased went to the wire does not appear from the testimony of the witnesses who were present at the time. One of them testified that he could not have been closer to the wire than 14 inches. It appears quite probable from the testimony of the expert electricians that the deceased did not receive the shock which killed him through the cord which he held in his hand; but that some part of his person or clothing came in contact with the wire, or was so close to the wire that the electricity 'sparked' or 'jumped' from the wire to his person. While standing so near the wire and being employed in trying to adjust the cord and pole he might readily have inadvertently moved nearer to the wire. At all events, it is clear that he unnecessarily, heedlessly and recklessly placed himself in a most dangerous position which resulted in his receiving the deadly shock. 'No other inference than that of negligence can be drawn from' his conduct. It was careless and negligent in the extreme sense, and is fitly characterized by the old phrase 'foolhardy.' Our opinion is that he was guilty as a matter of law of contributory negligence."

Obituary.

MR. CHARLES M. WHITE, secretary of the White Electric Company, of Buffalo, N. Y., died at his home in this city Nov. 16. Mr. White was 38 years old, and graduated from Cornell University in 1891 as a mechanical and electrical engineer. Mr. White worked for the American Telegraph & Telephone Company in New York City. Later he helped to form the White Electric Company in Buffalo. He is survived by his parents and one brother, Mr. Henry G. White.

COL. G. H. DAY.—We record with deep personal regret the death of Col. George H. Day, one of the fathers of the bicycle and automobile industries in this country. He died at his winter home, Daytona, Fla., on Nov. 21, of heart disease. George Herbert Day was born in 1851 at Brooklyn, Conn., and graduated from Hobart College and entered commercial life in Hartford, Conn. In 1877 he became the president of the Weed Sewing Machine Company, at Hartford, which contracted to manufacture the first bicycles for Col. Albert A. Pope, under Mr. Day's direction. The manufacture of bicycles soon superseded all the other work of his company, until in 1890, when the Pope Manufacturing Company, then with headquarters in Boston, absorbed the Weed Sewing Machine Company. In 1897 Col. Pope and Mr. Day, through the Pope Manufacturing Company, developed what was then the greatest surprise in the bicycle business, namely, the chainless bicycle. In 1887 one of the Columbia tricycles at the Hartford plant had been equipped with electric batteries and motor, but it was in 1894 that the question of self-propelled vehicles was taken up actively by the company and the motor carriage department organized. In 1899 the Columbia automobile interests were combined with the Electric Vehicle Company, of New York, and Mr. Day was elected to the presidency of the Columbia Automobile Company. Soon thereafter he was likewise elected to the presidency of the Columbia & Electric Vehicle Company, and became the president of the Electric Vehicle Company when the manufacture of Columbia automobiles and distribution was concentrated in that company. At this time he also was elected to the presidency of the Electric Storage Battery Company. During his incumbency the Riker Motor Vehicle Company was absorbed by the Electric Vehicle Company. In 1899 the interests which he represented acquired the control of the Selden patent, and after several years of litigation all suits pending were disposed of, and, largely due to Mr. Day's energies, all litigants were brought together with the best manufacturers in the country by the granting of licenses under the Selden patent and the formation on March 5, 1895, of the Association of Licensed Automobile Manufacturers. Thereupon Mr. Day resigned the presidency of the Electric Vehicle Company to accept the general management of the Association of Licensed Automobile Manufacturers, to which he devoted his time and energy, resulting in the rapid upbuilding of the strong association of wide influence now recognized throughout the United States and abroad. Mr. Day had likewise been prominently identified with the Western Automobile Machine Screw Company, of Elyria, Ohio, and the Hartford Machine Screw Company, in addition to which he was a director in a number of Hartford (Conn.) banks and three or more Connecticut insurance companies, as well as several other corporations. He was also a director of the Underwood Typewriter Company and one of the trustees of the Colt estate in Hartford, Conn. Only recently he had resumed his connection with the Licensed Association as the representative on its Executive Committee in behalf of the Electric Vehicle Company.

Personal.

SIR CLIFTON ROBINSON.

SIR CLIFTON ROBINSON, the well-known leader in English electric traction matters and management, is again visiting this country after an interval of some years. He is a native of Birkenhead and was one of the earliest associates of George Francis Train, who built the famous tramway in that town. In 1866 he accompanied Train to this country, remaining five years and acquiring an intimate acquaintance with American street railways. He returned to Great Britain in 1871 and became connected with the Cork Tramways. Four years later he became interested in the Bristol system, and then again in the Edinburgh, introducing the cable there. In 1884 he was the pioneer in the introduction of the cable in London. In the early stages of electrical development he came back to America, studied the whole situation, served as a special committee for the American Street Railway Association, and on his return to England, in 1891, became the advocate of electricity. In 1895 he was the engineer of the pioneer trolley system installed at Bristol, and since that time he has been constantly active in a variety of kindred enterprises. He is to-day managing director and engineer of the London United Electric Tramways and a director in the underground systems of London. He was knighted by King Edward in 1905. He is a member of the Institution of Electrical Engineers of England and an associate member of the Civil Engineers. He has been the author of many technical contributions to societies and the press, and has received the silver medal of the Royal Society of Arts. He has met many old friends on this trip, and on Nov. 26 was entertained at luncheon at the Engineers' Club by Mr. James H. McGraw, when he met several of the leaders in the street railway systems of New York City.

MR. ROY PARKINSON, of Lowell, Mass., has been appointed superintendent of the Whitman branch of the Edison Electric Illuminating Company, of Brockton, Mass., taking the position made vacant by the resignation of Mr. Warren Redding.

MR. SAMUEL COOK, chief electrician for the Northampton Electric Lighting Company, has resigned his position to accept a similar position elsewhere. Mr. Cook has been in the employ of the Northampton Company for 10 years, and has been chief electrician for five years.

MR. A. B. CARLETON.—Advices from Newark, N. J., state that Messrs. A. B. Carleton and Colonel Charles A. Sterling, vice-presidents of the Public Service Corporation of New Jersey, have resigned, as has Mr. Fred Evans, secretary, who will be succeeded by Colonel Hine.

MR. CHAS. C. LAPHAM, general manager and secretary of the Pacific Wireless Telegraph Company, Los Angeles, Cal., is spending some time in New York City in the interest of his company, which is arranging to install telegraph stations in the East for wireless communication overland.

MR. WARREN S. HALL, of Allentown, Pa., has resigned as vice-president and general manager of the Lehigh Valley Transit Company, the resignation to take effect Dec. 1. Mr. Hall has also resigned as director of the Allentown Electric Light & Power Company, to become effective at the convenience of the board of directors.

MR. H. VANCE LANE, vice-president and general manager of the Nebraska Telephone Company, has been elected president of the Rocky Mountain Telephone Company, with headquarters at Salt Lake City, Utah, to succeed Mr. George Y. Wallace, resigned. Mr. Lane has been connected with the Nebraska Telephone Company for 25 years.

MR. J. W. McFARLAND has been appointed general superintendent of the Macon Railway & Light Company, of Macon, Ga. Mr. McFarland was formerly superintendent of the Chattanooga Electric Railway Company, of Chattanooga, Tenn., which position he held for 10 years, and previous to that was general superintendent of the Savannah Electric Company, Savannah, Ga., for eight years.

MR. C. W. WHITNEY has resigned as manager of the publicity department of Abner Doble Company and accepted a position as purchasing agent with the Ransome Concrete Company, of California, whose main offices are in the Crocker Building, San Francisco. In addition to the regular duties of his new office, Mr. Whitney will have charge as well of publicity matters for which his experience well qualifies him.

MR. GEORGE Y. WALLACE, of Salt Lake City, Utah, has resigned as president of the Rocky Mountain Bell Telephone Company, which operates in Utah, Montana, Wyoming and Idaho. Mr. Wallace has held the office of president for 20 years. He will remain with the company as chairman of the executive board, and will thus have a large voice in directing its affairs.

MR. L. C. MARBURG, until recently connected with the Allis-Chalmers Company as engineer to the contracting department, has just returned from a two months' vacation trip to Europe. During his stay abroad, Mr. Marburg has investigated some of the recent gas engine, steam turbine and electrical work in Germany and Switzerland. He has not yet decided upon any definite plans for the future, but at present is making his headquarters in New York. Before joining the Allis-Chalmers forces in 1904, when the company entered the electrical field, Mr. Marburg had been connected with the railway department of the General Electric Company for over four years. Among the plants recently designed and partly installed under Mr. Marburg's supervision may be mentioned the main and sub-stations of the Indianapolis, New Castle & Toledo Electric Railway Company.

MR. T. STEBBINS.—Mr. Theodore Stebbins has accepted the position of general manager of the Texas Traction Company, which will put in operation within a few months an interurban railway between Dallas and Sherman, Tex. The line is being built by the American Railway & Lighting Co., which owns and operates six electric lighting and gas properties in the neighborhood of Dallas, with which Mr. Stebbins is also connected and for whose lighting properties he will act in an advisory capacity. Mr. Stebbins on graduation from the Massachusetts Institute of Technology, in 1886, became connected with the old Thomson-Houston Company and had charge of its interests in connection with the many local electric railway and lighting companies in which it was part owner. In 1904 he resigned from its successor, the General Electric Company, to accept the general managership of the important system of interurban railways centering in Columbus, then owned by Mr. A. E. Appleyard. When these went into the hands of a receiver Mr. Stebbins was appointed manager under the receivers and conducted their operation until the early part of 1906, when their mortgages were foreclosed and they were reorganized. Just at this time the National Civic Federation commenced its investigation of the management of public utility companies, and Mr. Stebbins was offered and accepted the position of expert on electric lighting properties during the investigation. He has recently returned from an extensive trip to South America and Europe, undertaken for American and London financial interests. Mr. Stebbins presented papers on economic subjects at the last two meetings of the American Street & Interurban Railway Association, and is universally recognized as a highly expert engineer and statistician.

Business Notes.

THE INDEPENDENT PNEUMATIC TOOL COMPANY, of Chicago, Ill., has appointed Mr. George A. Gallinger manager of the Pittsburg, Pa., office, at 1210 Farmers' Bank Building, where a complete line of Thor pneumatic tools and spare parts will be carried. Mr. Gallinger was formerly connected with the Chicago office.

THE INTERNATIONAL ELECTRIC & ENGINEERING COMPANY, of New York City, has moved from 150 Nassau Street to 148 Chambers Street, where it occupies a whole floor, which is divided into a stock room, office and a show room, and where it will pay special attention to the export trade, and to the selling of a general line of electrical supplies, besides handling special machinery. The firm is composed of Ralph Straschnow and Felix F. Wiener.

MESSRS. HAMPSON & FIELDING, of 1711 Tremont Street, Denver, Col., mining, milling and smelting machinery dealers, have established an electrical department, and in the future will carry a full line of electrical apparatus and supplies. The complete installation of lighting and power plants, and especially those for mine service, will be given special attention. They also conduct a general engineering business. L. M. McBride, formerly electrical engineer and superintendent of the Carstarphen Electric Company, has been placed in charge of the new department.

THE WHEELER CONDENSER & ENGINEERING COMPANY will remove its general offices from New York, N. Y., to its works at Carteret, N. J., on Jan. 1, 1908. The company is erecting an extensive addition to its present office building in Carteret to provide for the executive offices and to accommodate the increased force. Mr. William S. Love, who for the past eight years has had charge of the business of the Wheeler Condenser & Engineering Company in the Central West, and who for the past year has been in New York as general sales manager, will resume charge of the Chicago office of the company, at 1137-8 Monadnock Building, on Jan. 1, 1908.

THE BELL ELECTRIC MOTOR COMPANY, of 140-142 Prince Street, New York, N. Y., is making arrangements to move its factory from 435-437 West Broadway, New York, to Garwood, N. J., where it is erecting a plant, which will consist of a main erecting building, 100 ft. x 200 ft.; main repair shop, 50 ft. x 175 ft., and a power plant, 40 ft. x 60 ft. The company has installed a boiler plant and a hot-air system of heating, and is arranging to operate all its machinery by individual motors. The power plant will have a 100-hp equipment. The company manufactures motors and dynamos for power and lighting and does a general electrical engineering business.

THE FREDERICK PEARCE COMPANY, 18 and 20 Rose Street, New York City, which has long been known to our readers as expert manufacturers of high-class electrical mechanisms, especially those pertaining to telephone and telegraph work, police and fire alarm systems, etc., and which, something over a year ago, took over the business of the Willyoung & Gibson Company, widely known makers of high-grade electrical test instruments and scientific apparatus, announces that it has arranged with Mr. Elmer G. Willyoung, the former head and expert of the Willyoung & Gibson Company, to take charge of its instrument department. Associated with Mr. Willyoung will be Mr. Walter H. Pearce, son of Mr. Frederick Pearce. Both of these gentlemen are technically trained men of wide experience in this particular line. Besides the full line of Willyoung instruments, which will be made, including the well-known Willyoung induction coils for X-ray and wireless work, this department solicits special work of any kindred sort where exactness and finish in detail is required.

THE BALL & WOOD COMPANY, Elizabethport, N. J., announces to its customers and to all users of compressed air, the addition to its well-known engine business of a line of high-grade air compressors of new and advanced type, designed to meet the modern requirements for air compressing machinery equal in material and workmanship to the highest class of steam engine construction. These compressors are the product of its long experience in the design and manufacture of high-grade engines, combined with important new improvements in the air compressing elements of the machine. They are liberally designed, with large bearings and wearing surfaces, rigid frames, effective lubrication, ample valve areas and intercooling capacities, securing compressors which operate with minimum noise and friction and at the highest economy. Owing to the increased efficiency and output of these machines, they are offered at a price, based on actual capacity, which compares favorably with compressors of inferior design and cheap construction. Inquiries and investigation are invited.

SUNBEAM TANTALUM LAMPS.—The Western Electric Company reports large increasing business in the Sunbeam tantalum lamp. Many users are substituting this lamp entirely for the old-style carbon filament lamp. It is interesting to compare the service of these two lamps. The tantalum, as is well known, gives 20 cp and consumes only 40 watts, whereas the regular lamp gives 16 cp and consumes anywhere from 56 to 64 watts. While the first cost of the tantalum lamp is much higher, the saving resulting from its use will very soon more than pay its entire cost. The light given by the tantalum lamp is of a much whiter and more beautiful quality than heretofore known, and it has been the general experience that those who once try these lamps want them again. During the past two months more than 125,000 tantalum lamps were ordered for the sole purpose of replacing an equal number of the old type carbon filament lamps, which in itself is a very significant fact. It means that the tantalum lamp is to play a very important part in the future of electric lighting.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOV. 19, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

871,098. MEANS FOR DRIVING MOTOR ROAD VEHICLES; Martin Albrecht, Friedberg, Germany. App. filed Feb. 20, 1907. An electric transmission for motor vehicles, including motors geared to the front wheels and driven by a generator on the transmission shaft, which has the usual gear connections to the rear wheels.

871,112. INDIVIDUAL ELECTRIC GAS LIGHTER; William K. Davidson, Boston, Mass. App. filed March 4, 1907. A small dry battery and coil are enclosed within a casing of a form adapted to be hung compactly on a gas fixture.

871,139. ELECTRICAL SWITCH; Franz Orzel, Frankfort-on-the-Main, Bockenheim, Germany. App. filed Dec. 19, 1904. Electric snap switch having a spindle with a switch element sleeved thereon and having a torsional spring temporarily held against action by a plate having notches or depressions.

871,153. ELECTRIC HEATER; Hugh M. Wickem, Brooklyn, N. Y. App. filed Jan. 26, 1907. The water is led through a plurality of metal tubes having a spirally wound resistance element thereon and insulated from the metal by an asbestos sleeve.

871,161. ART OF PRODUCING PIGMENTS BY ELECTROLYSIS; Edwin D. Chaplin, Boston, Mass. App. filed Feb. 3, 1906. The process of making white lead, which consists in electrolytically dissolving metallic lead in an aqueous solution of a non-akaline salt in the presence of a solube chlorate salt.

871,162. ART OF PRODUCING PIGMENTS BY ELECTROLYSIS; Edwin D. Chaplin, Boston, Mass. App. filed Feb. 3, 1906. Process similar to above patent for making lead chromate.

871,168. ELECTRIC BELL; Henry J. Heeney, Boston, Mass. App. filed Feb. 12, 1906. A protected bell for out-of-door use, the bell being fastened within a depending hood or sheathing so as to be protected from the elements.

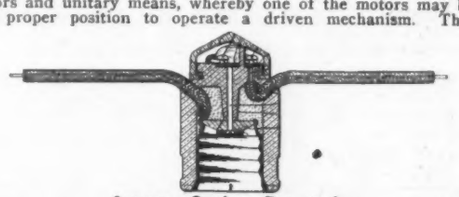
871,171. VAPOR RECTIFIER SYSTEM; Osias O. Kruh, Schenectady, N. Y. App. filed March 13, 1907. System whereby vapor electric devices may be utilized for supplying current to a load circuit which is subject to a back flow of energy, such as is formed by an induction coil and its interrupter. Has an inductive current path in shunt with said load and a non-inductive path for current also in shunt with said load.

871,184. TREEING-IRON; Charles W. Richards, Needham, Mass. App. filed Aug. 16, 1906. Tool used in forming boots and shoes and including a specially formed metallic box or chamber containing a resistance element.

871,189. ALTERNATING-CURRENT MOTOR; Leo. Schuler, St. Louis, Mo. App. filed April 22, 1904. Relates to alternating-current induction motors and particularly to means for reversing their direction. The motor is provided with a sub-divided field winding, the electrical connections of which are moved at the will of the operator to reverse the direction of movement of the rotary member of the motor.

871,192. OUTDOOR RECEPTACLE; James S. Stewart, New York, N. Y. App. filed June 6, 1906. A form of incandescent lamp receptacle for outdoor wiring. Is designed to be absolutely protected against ingress of water and contains a fuse in a specially constructed chamber. The threaded shell is positioned within this cup-shaped porcelain housing by a central projecting boss through which the central stud terminal extends. In this way a space is left for the wire connections.

871,193. ARRANGEMENT FOR MOTOR DRIVES; Emmet W. Stull, Norwood, Ohio. App. filed June 30, 1906. Has a plurality of motors and unitary means, whereby one of the motors may be moved into proper position to operate a driven mechanism. The motors



871,192—Outdoor Receptacle.

are fixed to a pivoted platform so as to swing into mesh with a shaft having gears.

871,199. CONTROLLER FOR ELECTRICALLY OPERATED MACHINE TOOLS; John R. Back, Worcester, Mass. App. filed May 1, 1906. The range of movement of the controller handle is fixed by a stop which can be plugged into different holes in the face of the controller head.

871,205. CONTROLLING MECHANISM; Herbert W. Cheney, Norwood, Ohio. App. filed June 28, 1906. Provides means for breaking the main circuit of the motor in case the controller handle is moved too slowly and in case of overload and certain other improper conditions.

871,214. REVERSIBLE GALVANIC BATTERY; Thomas A. Edison, Llewellyn Park, N. J. App. filed Oct. 31, 1900. In a reversible galvanic cell, an alkaline solution; an electrode consisting of an insoluble metallic perforated inclosing pocket and a finely divided insoluble active material tightly packed in such inclosing pocket; and a second electrode, substantially as set forth.

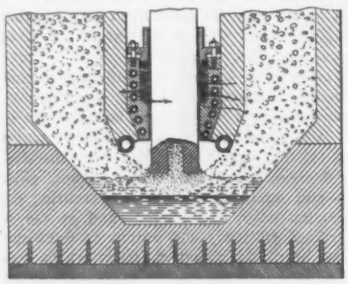
871,220. CONTROLLER; Thomas Gilmore, Jr., Norwood, Ohio. App.

filed Oct. 31, 1906. Construction designed to reduce the length of the drum, and consequently the height of a series parallel controller adapted to heavy currents.

871,238. DEVICE TO DISCLOSE SHUNTING OF THE CIRCUITS AROUND ELECTRIC METERS; William L. Saunders, Denver, Col. App. filed June 27, 1905. A device adapted to disclose shunting of the current in the wire leading into an electric meter and the service wire leaving it, and provides for the detection of attempts made by unauthorized and fraudulently inclined persons to cut the meter out of the electric circuit.

871,239. SYSTEM OF MOTOR CONTROL; William F. Schneider, Norwood, Ohio. App. filed Nov. 11, 1905. Has a motor and two sources of current supply and remotely controlled means for connecting said motor to the two sources of supply in parallel or to one of said sources alone.

871,273. ELECTRIC FURNACE AND METHOD; Paul L. T. Heroult, LaPraz, France. App. filed May 3, 1907. Construction of electric furnace having a pair of electrodes with a conductor adapted to form



871,338—Electric Furnace.

part of the path of the current there between and means for shifting the conductor to vary the length of the part of the path formed.

871,298. MAGNETIC SEPARATOR; Alfred Schwarz, New York, N. Y. App. filed Feb. 1, 1906. Concentrator table having riffles with magnets arranged beneath and closely adjacent thereto which are energized in a predetermined order to cause a transfer of the magnetic ore.

871,301. MAGNETIC SEPARATOR; Alfred Schwarz, New York, N. Y. App. filed April 7, 1906. Relates to modifications of the above.

871,338. ELECTRIC FURNACE; Paul L. T. Heroult, LaPraz, France. App. filed April 21, 1906. Features of construction of an electric furnace having special means for establishing good contact with the central electrode.

871,348. PANEL BOARD; Hubert Krantz, Brooklyn, N. Y. App. filed July 6, 1905. Has bus-bars cross-connected to the terminals of a plurality of fuse receptacles and adapted to be engaged directly by the fuse plugs therein.

871,352. SPRING BINDING POST; Horace G. Martin, Rutherford, N. J. App. filed Oct. 27, 1905. Sheet metal binding post having a bar with a transverse hole and a perforated washer spring impelled on said bar in the direction of said hole.

871,360. ELECTRIC AND PNEUMATIC GOVERNOR; William K. Rankin and Thomas F. Kelly, Philadelphia, Pa. App. filed Feb. 11, 1907. Relates to features of construction, including a plurality of horizontally operating and resiliently yielding catches with flattened tops and means to insure the flat top being always uppermost.

871,365. MAGNETIC SEPARATOR; Alfred Schwarz, New York, N. Y. App. filed Feb. 1, 1906. Relates to modification of No. 871,298.

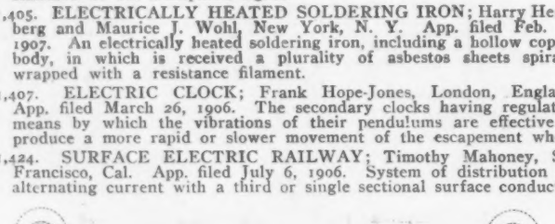
871,367. MAGNETIC SEPARATOR; Alfred Schwarz, New York, N. Y. App. filed April 7, 1906. Covers additional modifications.

871,378. RAILWAY SIGNAL; Louis H. Thullen, Edgewood, Pa. App. filed March 18, 1905. Mechanical construction for operating a semaphore arm from an iron-clad solenoid magnet disposed within the standard of the semaphore signal.

871,405. ELECTRICALLY HEATED SOLDERING IRON; Harry Hertzberg and Maurice J. Wohl, New York, N. Y. App. filed Feb. 11, 1907. An electrically heated soldering iron, including a hollow copper body, in which is received a plurality of asbestos sheets spirally wrapped with a resistance filament.

871,407. ELECTRIC CLOCK; Frank Hope-Jones, London, England. App. filed March 26, 1906. The secondary clocks having regulating means by which the vibrations of their pendulums are effective to produce a more rapid or slower movement of the escapement wheel.

871,424. SURFACE ELECTRIC RAILWAY; Timothy Mahoney, San Francisco, Cal. App. filed July 6, 1906. System of distribution for alternating current with a third or single sectional surface conductor-



871,348—Panel Board.

rail, which will avoid electrolysis of water and gas pipe mains. Has specially arranged reactance windings or choke coils.

871,442. TROLLEY POLE ATTACHMENT; Robert P. Rever, Newark, N. J. App. filed Nov. 26, 1906. The upper section of the trolley pole has a yielding spring connecting with the main portion so as to yield in a lateral or in a forward and back direction.

871,457. ELECTRICALLY PROPELLED VEHICLE; Russell Thayer, Philadelphia, Pa. App. filed April 4, 1907. Has depending conductor shoes, which may be dropped into engagement with the track rails so as to keep connection therewith, notwithstanding deviations of the vehicle therefrom.

871,468. TELEPHONE MOUTHPIECE; Anna Bebout, St. Louis, Mo. App. filed Jan. 28, 1907. A collapsible individual mouthpiece for telephones comprising a plurality of sections, the mouth section being such a length that the other sections may be housed within the same, connections between the sections permitting such housing, and closures hinged at opposite ends of the mouth section.

871,470. TELEPHONE RECEIVER; Hiram E. Booth, Salt Lake City, Utah. App. filed Sept. 8, 1902. In a telephone receiver, the combination of a vibratory diaphragm, means for causing said diaphragm to vibrate for the purpose of producing sound-waves, and a porous and non-vibratory diaphragm arranged to receive the sound waves propagated by the vibratory diaphragm, with an air space between, said last-mentioned diaphragm consisting of front and back discs with interposed fibrous material.

871,479. ELECTROGENIC BODY DEVICE; Albert R. Cooper, Findlay, Ohio. App. filed Feb. 14, 1907. Construction of shoe having a small dry battery included in the heel thereof.

871,484. ELECTROMECHANICAL POWER GOVERNOR; George H. Davis, West Orange, N. J. App. filed Feb. 13, 1906. Has means for causing a plurality of electromagnets to act with differing force on a governor device comprising a sectional bar.

871,485. TELEPHONE WALL-SET; William W. Dean, Chicago, Ill. App. filed June 15, 1903. Telephone wall-set, including a casing which pulls down to expose interior call bell mechanism.

871,490. INSULATOR PIN MOUNTING; John D. E. Duncan, New York, N. Y. App. filed Jan. 21, 1907. The insulator pin is mounted on the cross arms of the pole by staples with threaded ends engaged by nuts. Has transverse cleats beneath the pin through which the staples pass.

871,496. PROTECTION OF RAILWAY TRAINS; Abel R. A. Gerard, Pontgivart, near Reims, France. App. filed May 1, 1906. Semi-automatic block signal system for railway, in which the train itself effects the operation of setting the signals after passing a section and in which the completion of the signals are effected by a local operator.

871,501. BOND FOR RAILS; Charles Y. Haile and George M. Hugus, Uniontown, Pa. App. filed May 17, 1907. The bond rail is passed in a zig-zag path through the web of the rail and through the fish plates thereof so as to prevent such fish plates from being surreptitiously removed.

871,513. ALTERNATING CURRENT MOTOR; Carl A. Lohr, Schenectady, N. Y. App. filed Sept. 7, 1905. In combination with an alternating current rotary field motor having a stator and a rotor, said stator having a number of poles different from the number of poles of said rotor, means for electrically connecting at will said stator or said rotor to a source of electricity.

871,519. PARTY-LINE TELEPHONE EXCHANGE; Samuel A. Norstrom, Chicago, Ill. App. filed July 14, 1905. The combination with a party line having a series of local stations thereon, and means controlled from a central office for causing the simultaneous advance of all switching mechanisms, of means also controlled from the central office for causing selected ones only of said switching mechanisms to return to normal position.

871,520. TELEPHONE EXCHANGE; Nils E. Norstrom, Chicago, Ill. App. filed Aug. 21, 1905. The combination with a ratchet wheel having one tooth removed, a driving pawl, and a holding pawl, of a special pawl, and a magnet for causing said special pawl to engage said wheel so that the driving pawl can drive the toothless part of said wheel past the holding pawl.

871,535. ELECTRIC WIRE CONNECTION; Frederick B. Thatcher, Providence, R. I. App. filed Jan. 31, 1907. A spark plug connection terminal having somewhat the form of a garter clasp to engage over a metallic button on the spark plug.

871,537. VOLTAGE REGULATOR; Max J. E. Tilney, South Kensington, Eng. App. filed Oct. 17, 1905. A method of automatically regulating voltage in electric light and power circuits with varying loads. Is specially applicable to circuits in which the load varies suddenly and to large amounts.

871,538. APPARATUS FOR INSURING SAFETY OF TRAFFIC ON SINGLE LINES OF RAILWAY; Edward Tyler, Dalston, London, Eng. App. filed Nov. 15, 1905. Method of working railway lines by the staff system in which a tablet issued from an apparatus which may be electrically controlled, must be received by an engine driver before he can take his train to the next section.

871,616. TROLLEY POLE CONTROLLER; Clarence Norland, Los Angeles, Cal. App. filed Nov. 19, 1906. The pole is impelled upward by a spring and is retrieved by a pneumatic cylinder set in action by an abrupt upward movement of the pole.

871,652. AIR PURIFIER; Frank A. Ward, Los Angeles, Cal. App. filed Aug. 23, 1906. A rectangular box, contains an induction coil and a multitude of electrodes by which a high potential discharge can be passed therebetween. The ends of the box are perforated to permit a circulation of air therethrough.

871,667. PIPE CAP; William H. Blood, Jr., Wellesley, Mass. App. filed March 22, 1907. A form of hood for outlet connections of telephone conduits having among other features a plurality of minute projections around the edge which facilitate the draining of moisture therefrom.

871,675. OFFICE INDICATOR; Henry P. Davis, Hot Springs, Ark. App. filed Dec. 29, 1906. A form of mail box in which an incandescent lamp is displayed on pressing the call bell in case the party called is not at home.

871,686. PLATINUM CONTACT; Anton Freier, Boston, Mass. App. filed May 13, 1907. A method of making the contact screws for vibrators so that the contact element is formed of a thin sheet of platinum on a base of German silver, thereby economizing the platinum.

871,737. TELEPHONE TRANSMITTER; Elias E. Ries, New York, N. Y. App. filed Jan. 11, 1904. In a telephone transmitter, two plates or electrodes and a film of liquid included in a circuit between them and adapted to vary the resistance of the circuit through capillary action when a plate is vibrated, as and for the purpose described.

871,758. BRIDGING BLOCKS FOR DYNAMO ELECTRIC MACHINES; Edward Heitmann, Montclair, and Frederick W. Young, East Orange, N. J. App. filed Oct. 18, 1906. Has a slotted dynamo electric machine element with windings located in the slots, and cast-iron bridging blocks insulated from the element and consisting of parallel contact members joined by thin webs.

871,766. PROCESS FOR EXTRACTING GOLD AND SILVER FROM ORES; Gilbert Gurney, Berkeley, Cal. App. filed May 23, 1904. The process of extracting the values from sulfid ores, which consists in subjecting them to a solution containing perchlorid of a metal of two or more valencies, together with the chlorid of an alkali metal and a free mineral acid.

12,722. TROLLEY RETRIEVER; Alfred W. Knutson, Brookfield, Ill. App. filed Aug. 19, 1907. Covers a trolley retriever having a spring drum or reel which is rotated to retrieve the pole by a more powerful spring when the latter is tripped into action.